B.C.Hydro

Electric Load Forecast

1988/89 - 2008/09

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SUMMARY

PROBABLE ECONOMIC FORECAST

The Economy

The B.C. economy is forecast to average 3.0% real annual growth over the period to 1998 and 2.8% in the following 10-year period to 2008. The main growth sectors through 1998 in the industrial area are projected to be paper and allied products manufacturing, non-resource based manufacturing and construction. In the commercial area, community, business and personal services is expected to be the highest growth sector.

Although the overall economic growth is forecast to be nearly identical to that projected last year when averaged over the long term, the electric intensive sector of paper and allied products is higher this year through the first 10 years.

Population Growth

Population growth in the 1.4% range on an annual basis is projected through the 20-year period.

Energy Prices

Electricity prices are projected to decline in real terms by 1.5% per year for the first 10 years and remain flat in real terms (i.e. increase at the rate of inflation) thereafter. The result by 1998 is a real price decline of approximately 14%. Natural gas and light fuel oil prices are expected to increase marginally in real terms. However, natural gas is projected to maintain its competitive advantage over electricity (for heating) throughout the 20-year period.

Comparison With 1987 Forecast

	1988	1987
GDP Growth Rate (%/year)		
1987 to 1998	3.0	3.0
1998 to 2006	2.8	2.8
Population Growth Rate (%/year)		
1987 to 1998	1.4	1.3
1998 to 2008	1.4	1.4
Electricity Prices - Real Decline		
1987 to 1998	14%	28%
1998 to 2008	0%	0%

PROBABLE ENERGY FORECAST

The probable energy forecast developed in this document excludes consideration of the Interruptible Marketing (E+) and Demand Side Management (Power Smart) Programs. The impact of the Power Smart programs, which must be considered in planning functions, is a net (long term) decrease in load that will have to be served.

Energy Requirements

Electric energy requirements are projected to increase from 40,793 GW.h in 1987/88 to 55,290 GW.h in 1998/99 and 72,410 GW.h in 2008/09 for an annual

average growth rate of 2.8%.

Sales are projected to increase by 12,900 GW.h to 1998/99. The components of the projected increase are: residential provides 2,700 GW.h, commercial 4,300 GW.h, industrial 5,100 GW.h and other miscellaneous 800 GW.h.

Within the industrial area the paper and allied products sector is projected to grow by 3,500 GW.h by 1998/99. This electric intensive (mechanical pulping) load is thus expected to account for 55% of additional sales in the industrial area and 25% of total additional sales. Sales to the metal mining sector are projected to decrease by 1,200 GW.h with closures of several existing copper mines.

West Kootenay Power and Light (WKP&L) accounts for a large share of the growth in Other sales. Their requirements are forecast to increase by 650 GW.h by 1998/99, from less than 100 GW.h in 1987/88.

Table 1 provides the forecast by the main sectors for key years. Also shown is a breakdown to the integrated and non-integrated systems. Figure 1 is a graph of the forecast total gross requirements and historical actual growth.

Table 1
B.C. HYDRO PROBABLE GROSS LOAD REQUIREMENTS BY MAJOR SECTORS - SUMMARY
(Including SCL & WKP&L)

Fiscal Year	Residential (GW.h)	Commercial (GW.h)	Industrial (GW.h)	Other (GW.h) (1)	Total Sales (GW.h) (2)	Losses/ Accruals (GW.h)	TOTAL GROSS REQT'S. (GW.h)	Less Non-Integr. (GW.h)	Integr. System TOTAL GROSS REQT'S. (GW.h)	Peak (MW)
Actual 1987/88	9902	9060	16427	679	36068	4725	40793	167	40626	7060
Forecast 1998/99	12576	13355	21562	1455	48948	6350	55290	230	55060	9670
Avg. Ann.% incr. 11 years: 87/88-98/99	2.2%	3.6%	2.5%	7.2%	2.8%	2.7%	2.8%	3.0%	2.8%	2.9%
Forecast 2008/09	15024	19165	27865	2039	64093	8320	72410	320	72090	12650
Avg. Ann.% incr. 10 years: 98/99-08/09	1.8%	3.7%	2.6%	3.4%	2.7%	2.7%	2.7%	3.4%	2.7%	2.7%
21 years: 87/88-08/09	2.0%	3.6%	2.5%	5.4%	2.8%	2.7%	2.8%	3.1%	2.8%	2.8%

1. Inter-Utility transfers (including WKP&L) and firm export (including SCL).
2. Interruptible Marketing (E+) and Demand Side Management (DSM) programs not included.
3. The industrial and commercial categories do not correspond to B.C. Hydro's Rate categories. A breakdown of the above industrial and commercial sales into B.C. Hydro rate categories is presented in Section 3.

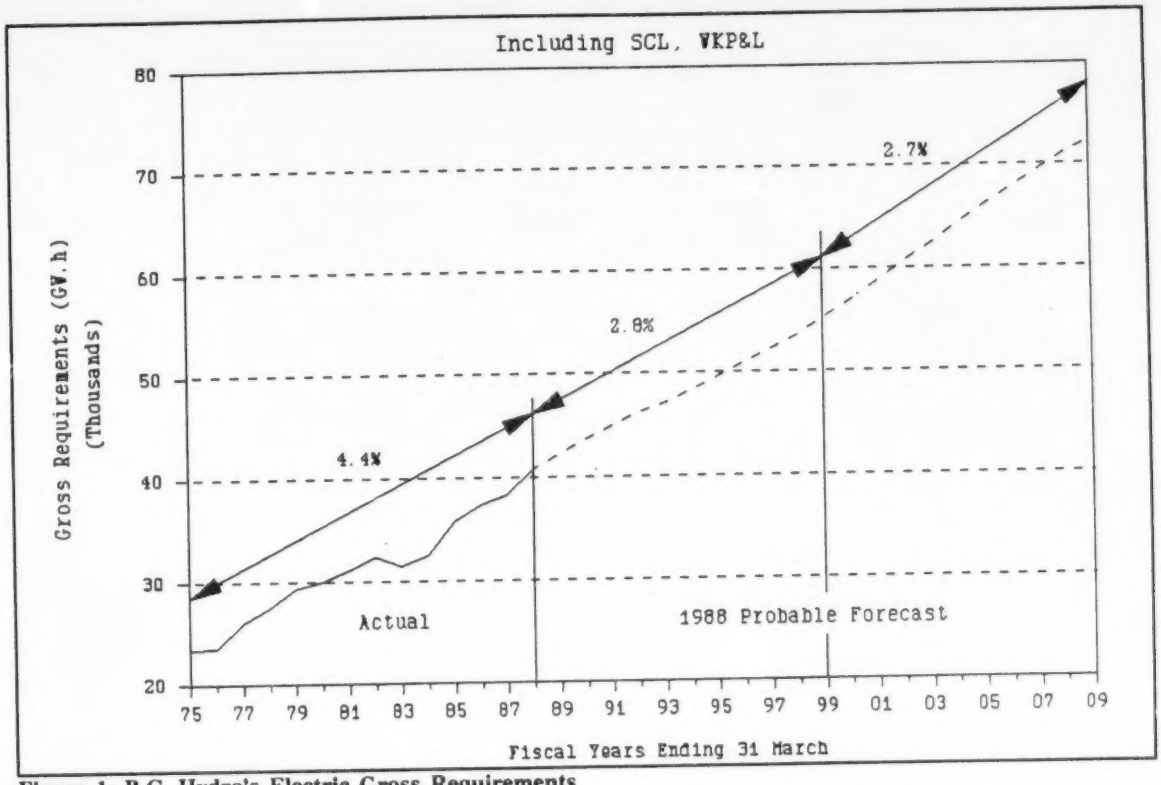


Figure 1: B.C. Hydro's Electric Gross Requirements

Significant Changes from 1987 Forecast

Higher sales to the commercial area of 550 GW.h are projected. Even with higher expected real electricity prices in this year's forecast, the average consumption levels are projected considerably higher. This expectation is in line with actual trends seen in our billing data over the last few years.

Higher sales to the paper and allied products sector of 500 GW.h are projected. This is based on recent activity and a higher sectoral GDP projection.

Higher sales to the industrial sector overall are projected. This reflects the noticeable trend to the use of electricity in B.C. as a means of productivity improvement. The competitive electricity prices in B.C. are also becoming noticeable to new customers considering locating in B.C.

Higher sales to WKP&L of 600 GW.h are projected. WKP&L's intent is to purchase their incremental requirements from B.C. Hydro whereas last year they were intending to generate their own.

Comparison with 1987 Forecast

This year's forecast is higher than last year's even with higher real electricity prices and the same overall GDP projections. There are two main reasons for this change:

- Although overall GDP is unchanged, there are some changes in the sectoral composition. The electric intensive manufacturing area (in particular the paper and allied products sector) is marginally higher in this year's economic forecast.

- A continuous increase in the electric intensity of the commercial and some of the industrial sectors. The use of electricity for productivity improvement in the industrial sector has been noted. In the commercial area conservation is not occurring at anywhere near the pace anticipated in the early to mid 1980's.

	1988	1987
Gross Requirements (GW.h)		
1998/99	55,290	52,880
2008/09	72,410	70,150
Average Annual Growth Rate (%/year)		
1987/88 to 1998/99	2.8	2.5
1998/99 to 2008/09	2.7	2.9
Forecast Advancement compared to the 1987 Forecast (years)		
by 1998/99	1.6	-
by 2008/09	1.3	-

RANGE OF ENERGY FORECASTS

A range of forecasts has been projected around the probable load forecast. As in the probable forecast, Interruptible Marketing (E+) and Demand Side Management (Power Smart) Programs are not included.

Uncertainties in the gross load forecast are quantified by a probability distribution developed by combining the variabilities in the future levels of forecast drivers such as economic conditions, energy intensity, etc. The probability distribution of the gross load forecast has been defined by four values: (i) the 5th percentile, (ii) the 25th percentile, (iii) the 75th percentile, and (iv) the 95th percentile.

The corresponding values of gross load requirements and growth rates are shown in the table below. By 2008:

(i) There is a 5% chance that load requirements will be below 50,960 GW.h.
(ii) There is a 5% chance that load requirements will be above 96,570 GW.h.
(iii) There is a 90% chance growth rate will be between 1.1% and 4.2%.

Gross requirements for the various forecasts for the integrated system (including SCL and WKP&L) are shown below:

	5th Percentile	25th Percentile	Probable	75th Percentile	95th Percentile
Gross Requirements (GW.h)					
1998/99	44,260	50,600	55,060	60,110	65,080
2008/09	50,960	62,520	72,090	83,630	96,570
Average Annual Growth (%/Year)					
1987/88 to 1998/99	0.7	2.0	2.8	3.6	4.3
1998/99 to 2008/09	1.4	2.1	2.7	3.4	4.0
1987/88 to 2008/09	1.1	2.1	2.8	3.5	4.2

Figure 2 is a graph of the forecasts.

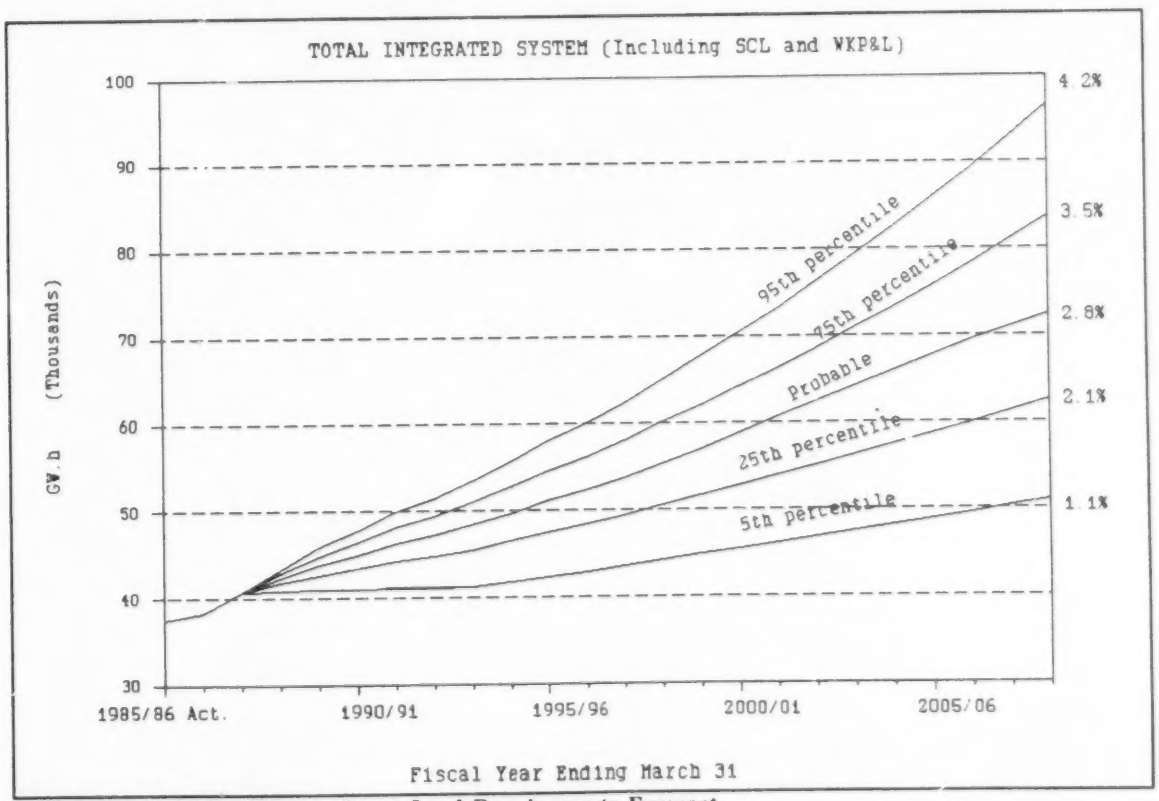


Figure 2: B.C. Hydro Electric Gross Load Requirements Forecast

DISCUSSION

The probable load forecast shows average annual growth rates of 2.8% for the period through 1998/99 and 2.7% for the following 10 years through 2008/09. This represents an addition to the existing load (40,793 GW.h in 1987/88) of 35% by 1998/99 and 77% by 2008/09.

When alternate scenarios are considered the possible additions to the present load are represented by a range. Through 1998/99, there is a 90% chance that the added load is of between 8% and 60% and by 2008/09, the range is between 25% and 137%. While the uncertainties appear very large, history tells us that unforeseen circumstances can and do cause major changes in load growth patterns.

In preparation of the 1988 forecast, several areas where emphasis and work must continue were identified:

- The question of uncertainty and quantifying via the probability distributions must remain as a priority.
- A continuing move to end use based models is required. They are necessary for scenario analysis, sensitivity studies and proper development, evaluation and incorporation of existing and anticipated Demand Side Management (DSM) programs.
- Additional load research is required and a program will be implemented. Data on how customers use electricity is needed in order to properly calibrate the end use models that in turn allow the provision of well based forecasts and DSM program evaluation.
- Sectoral economic information in projections by physical quantity (as well as growth rates) is being pursued for the 1989 forecast cycle. Use of end use based models that is being instituted requires forecast of physical quantities. Also, the provision of alternate forecasts with probabilities attached is made more credible when specific changes in physical quantities can be more easily estimated.
- Peak demand (MW) forecasting must receive increased emphasis. The impact of DSM programs, system operation changes (e.g. cooperation with other utilities) and alternate supply sources (e.g. parallel generation) will make peak demand considerations more critical, particularly at a sub-system level.

SECTION 1 - INTRODUCTION

1.1 ELECTRICITY SUPPLY AND USE IN B.C.

Total electricity generated/supplied for use in B.C. in calendar year 1987 was approximately 51,000 GW.h (183.5 Petajoules). Of this, B.C. Hydro supplied 39,400 GW.h or over 77%. The principal suppliers/users are as illustrated in Figure 1.1.

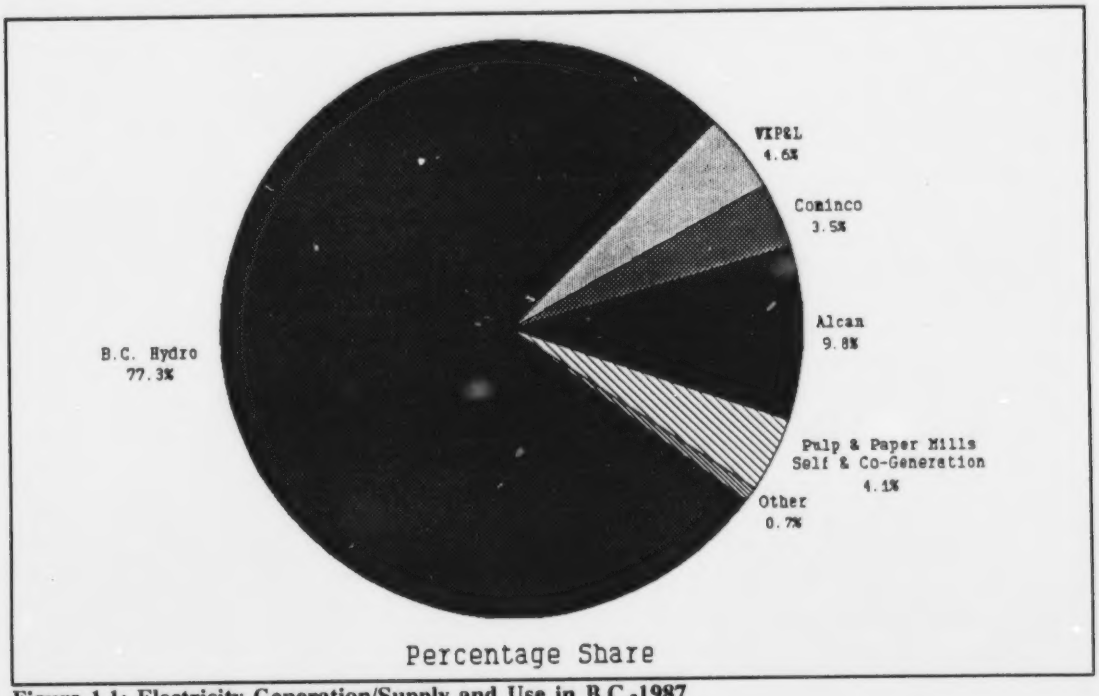


Figure 1.1: Electricity Generation/Supply and Use in B.C.-1987

1.2 LOAD GROWTH ON B.C. HYDRO DOMESTIC SYSTEM

Load growth on the B.C. Hydro domestic system over the last fiscal year is tabulated below. The domestic system excludes sales to West Kootenay Power & Light, Seattle City Light and export surplus, but includes domestic non-integrated areas (Zone II diesel districts).

Higher growth in gross requirements (6.4%) compared to sales (5.0%) was due to an increase in losses (as a percentage of sales) back to historical levels. The actual peak demand increase was higher than for energy due to a colder weather period occurring in 1987/88 than did in 1986/87.

	Actual 1986/87	Growth	Actual 1987/88	% Growth
Total Domestic Sales(GW.h)	33,978	1,701	35,679	5.0
Gross Requirements (GW.h)	37,970	2,434	40,404	6.4
Peak Demand (MW)	6,378	484	6,862	7.6
Weather Normalized Peak(MW)	6,715	420	7,135	6.3

1.3 ELECTRICITY USE VERSUS GDP IN B.C.

There is a very good historical relationship between growth in electricity use in B.C. and growth in Gross Provincial Domestic Product (GDP) as shown in Figure 1.2. On average, from 1961 through 1987, a 1% growth in real GDP has equated to a 1.2% growth in B.C. electricity use.

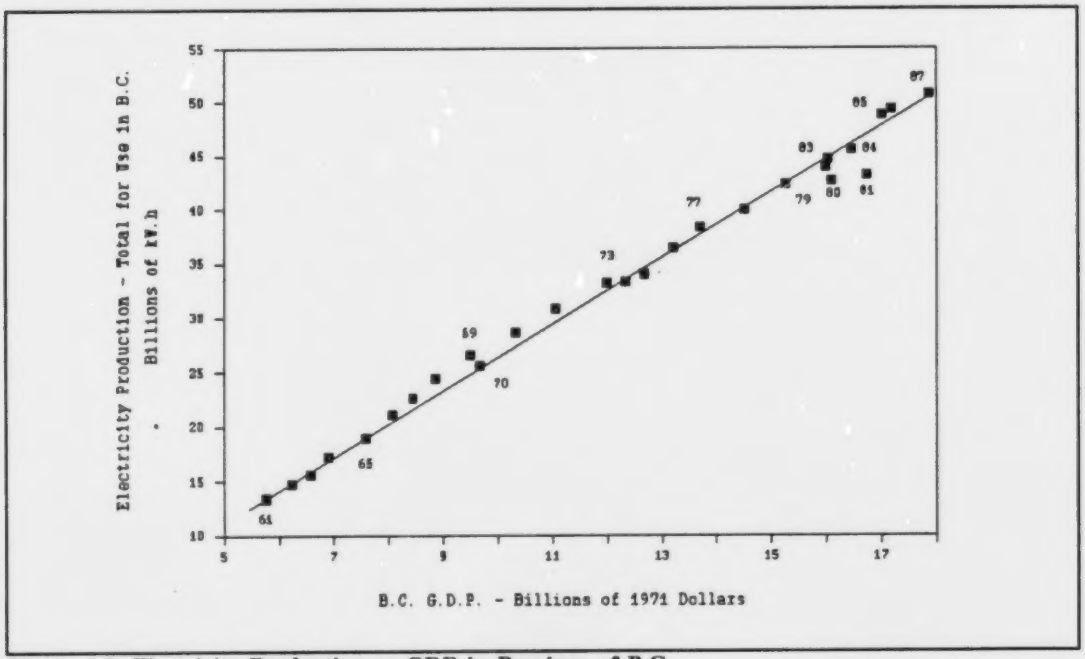


Figure 1.2: Electricity Production vs GDP in Province of B.C.

This relationship has held in spite of many factors occurring that individually could have caused it to deviate. Such factors have been; promotions to sell more electricity in the 1960's, the turn to serious energy conservation in the 1970's starting with rapid oil price increases, a trend to electric heating as oil prices increased, promotion of more efficient electric appliances, a trend to more electrical intensive processes in industry to improve productivity and efficiency.

Thus, while there is no reason to believe that this historical relationship will continue indefinitely, there is also no reason to expect a marked deviation. The result of this (1988) forecast is moderation of the

ratio of electricity growth to GDP to slightly under 1.0 over the 20 year period. This reflects a continuing emphasis on efficient energy use, a continuing move towards a (less electric intensive) service oriented economy and approaching limitations in further development of certain sectors of the electric intensive forest and mining industries. This ratio must be treated cautiously, however, since B.C. Hydro supplies only about 77% of the electricity used in B.C. and a projection of total electricity use in B.C. has not been made.

1.4 STRUCTURE OF DOCUMENT

This document presents details on B.C.Hydro's 1988 forecast of gross electric requirements through 2008/09 and is organized as follows :

Section 2 — provides the **economic, population and energy price assumptions** that drive the electric forecasts.

Section 3 — describes how the **probable (most likely) electric forecast** is built up from sales projections of the key sectors, i.e. residential, commercial, industrial and other. Consideration of the Interruptible Marketing (E+) and Demand Side Management (Power Smart) programs is excluded in the forecast development. The projections are done in detail for the first 10 years (through 1998/99) with year-over-year forecasts for the various categories and major customers. This allows for financial planning and detailed distribution and transmission planning to be carried out. The second 10 years is based on economic trend projections and is mainly used for resource planning which does not require the same level of detail.

Section 4 — deals with the inherent **uncertainty** in load growth which is a random variable with an expected value (the mean) and a standard deviation. It is necessary in planning to pay at least as much attention to the uncertainty in the forecast as it is to the probable outcome itself. A range of forecasts has thus been prepared around the probable forecast.

Section 5 — discusses the present status and effect of **Marketing and Demand Side Management (now called Power Smart)**, programs on actual load growth and load shape in the B.C. Hydro system. The Interruptible Marketing and Power Smart programs, while not factored directly into the 1988 forecasts, must be considered in system planning (resource, transmission and distribution).

Appendix A — provides details on the forecast **process** and **methodology**.

Appendix B — describes the method used to disaggregate the probable forecast by **rate categories**. It is required for revenue calculations and distribution planning.

Appendix C — defines the **B.C. Hydro system** and shows how the forecast is used in **system planning** and how consistency between the various uses is maintained.

SECTION 2 - ECONOMIC FORECASTS

2.1 SOURCE OF PROJECTIONS

The overall provincial economic growth and population projection were based on the latest (1988) long-term planning scenario of the B.C. Ministry of Finance and Corporate Relations.

Additional consultant input was obtained for some of the electricity intensive sectors. H.N.Halvorson Consultants Ltd. prepared an outlook for metal mining, coal mining and smelting industries and a projection for B.C. through the year 2005. Woodbridge, Reed and Associates prepared a 20-year world outlook for pulp and paper and a production projection for B.C.'s pulp and paper industry.

Electricity price projections were based on internal analysis of revenue requirements and financial performance. Natural gas and crude oil price projections were based on input from Confer Consulting Ltd.

2.2 PROBABLE ECONOMIC GROWTH

The probable economic forecast (Figure 2.1) , is based on an assumption of continuing stable economic conditions; moderate inflation; slowly declining interest rates; steady improvement in the rate of unemployment; and a return to the higher productivity growth rates normally found in stable investment climates similar to the 1987 forecast. Also assumed is expansion of world trade especially among countries in the Pacific Rim and the United States.

Overall, B.C. economic growth through 1998 is forecast to grow at an annual average rate of 3.0%. For the following 10 years through 2008, growth is projected to average 2.8%.

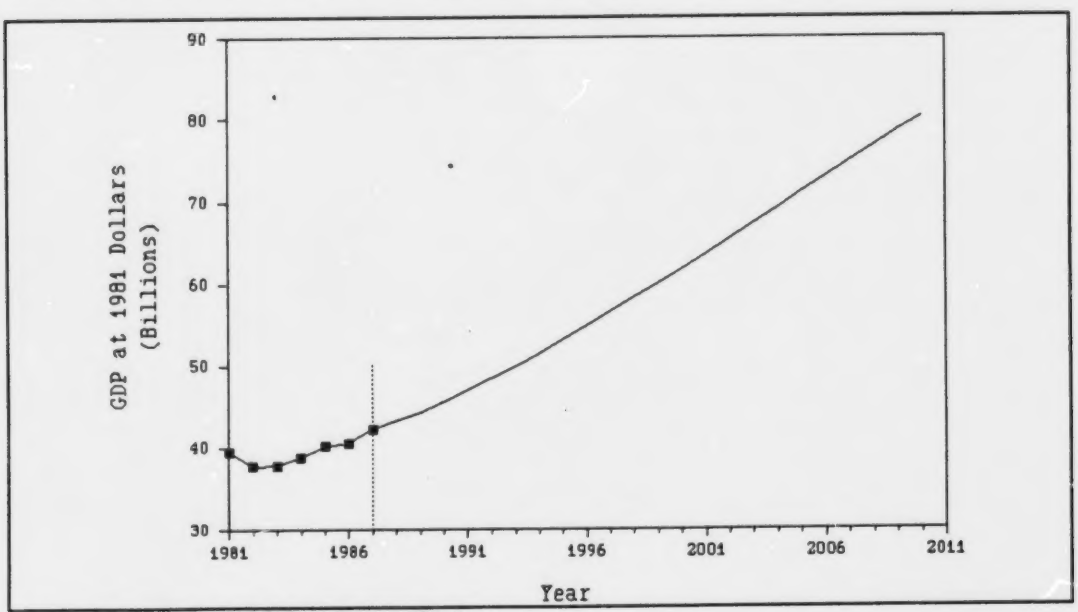


Figure 2.1: B.C. Real GDP at Factor Cost

2.3 POPULATION FORECAST

The Population for B.C. (Figure 2.2) is forecast to rise from 2,943,000 in 1987 at an average annual rate of 1.4% to 3,883,000 in 2008.

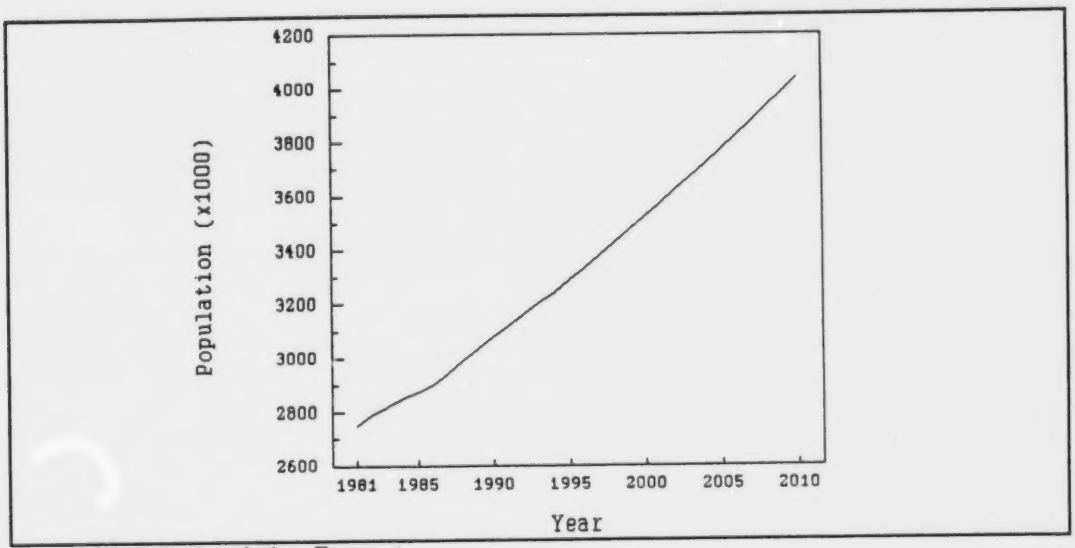


Figure 2.2: B.C. Population Forecast

The most volatile component of the population forecast is in-migration, particularly inter-provincial, as the natural increase is relatively constant.

The present positive trend of in-migration (Figure 2.3) is expected to increase as B.C.'s relatively strong economic performance provides more opportunities to residents of other provinces.

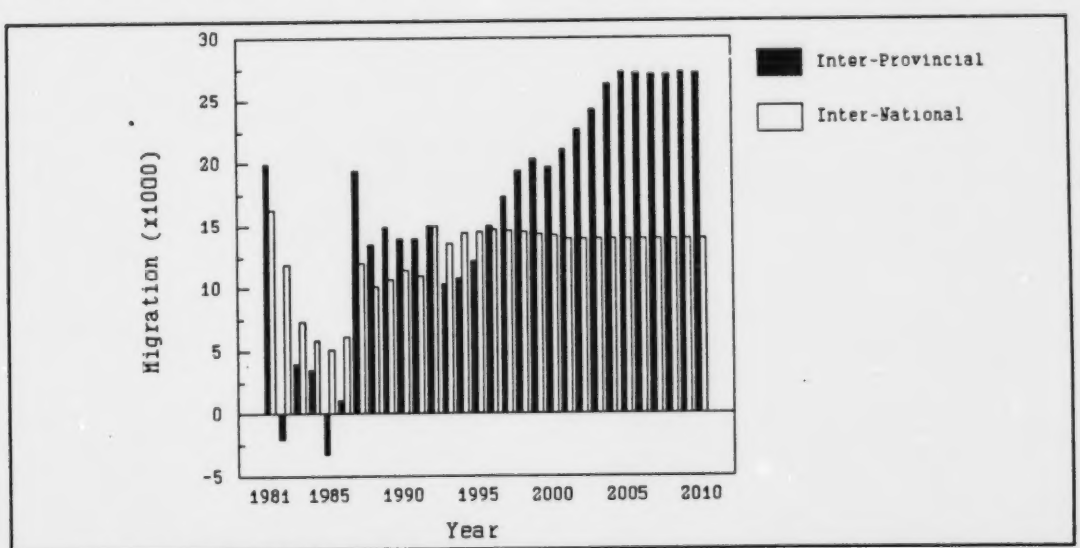


Figure 2.3: Net In-Migration

2.4 SECTORAL OUTLOOKS

The total industrial sector accounted for 32% and the commercial sector accounted for 68% of the provincial GDP in 1987. The commercial sector share (Figure 2.4) is expected to increase to 72% by 2008. This is a continuation of a long term trend.

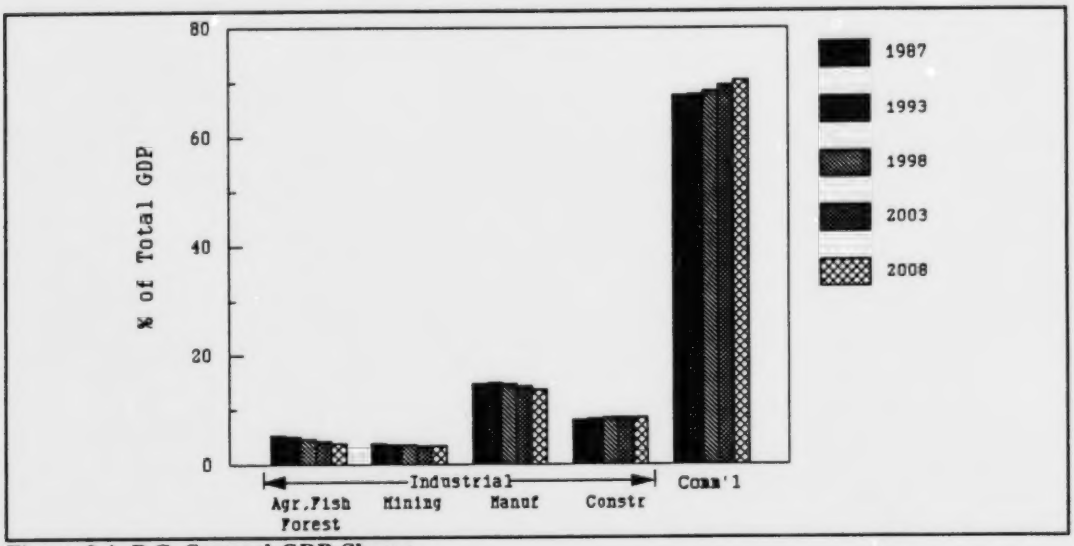


Figure 2.4: B.C. Sectoral GDP Shares

The commercial sector is projected to have higher long term growth rates (Figure 2.5) compared to total GDP. In the shorter term, manufacturing and construction push the industrial area growth rate up to that of the commercial sector.

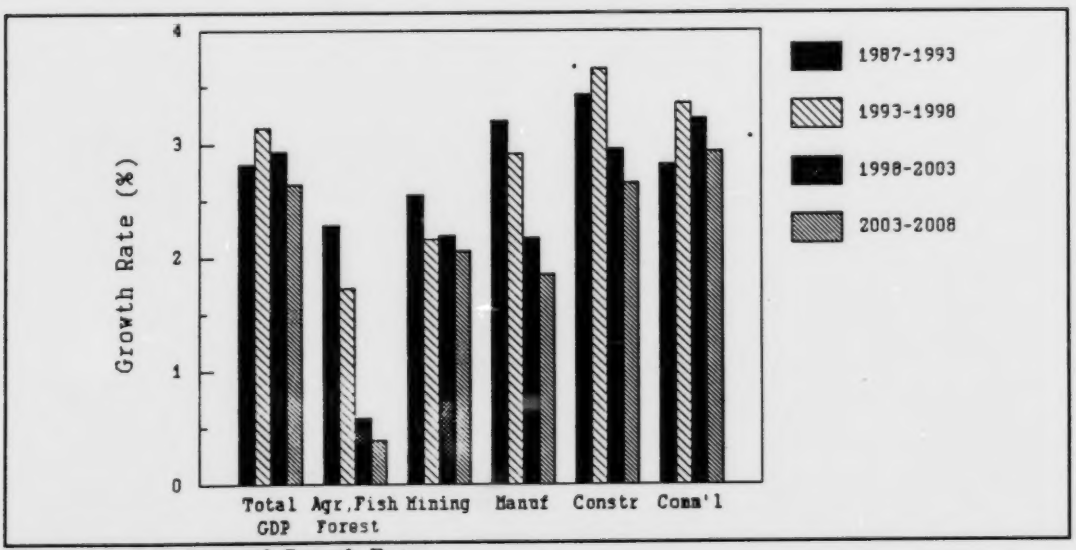


Figure 2.5: B.C. Sectoral Growth Rates

2.4.1 Agriculture, Fishing/Trapping and Forestry Sectors (Figure 2.6).

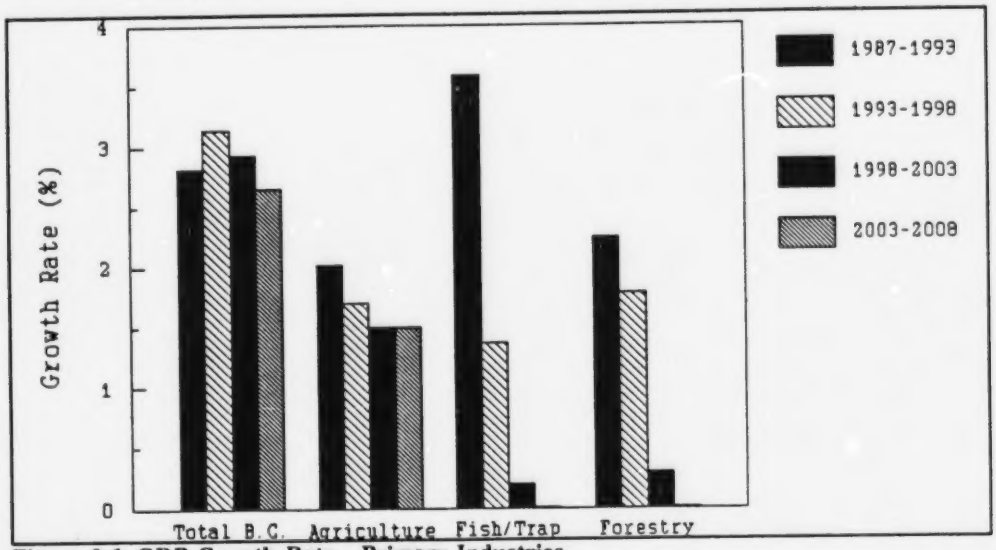


Figure 2.6: GDP Growth Rate - Primary Industries

Within these industries, primary forestry is the major sector accounting for 2/3 of the total. Long term growth is projected to approach zero as the allowable annual cut is reached.

2.4.2 The Mining Sector (Figure 2.7).

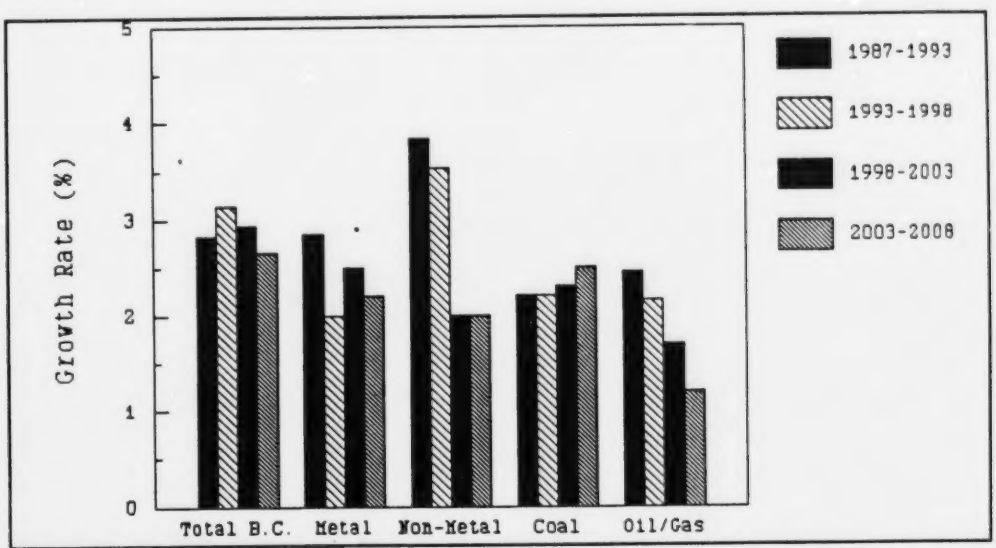


Figure 2.7: GDP Growth Rate - Mining Sector

Long term prices for copper, molybdenum and other non precious metals are projected to be considerably lower than the present levels and thus limit any appreciable growth in the metal mining sector. New production of these metals is expected to come largely from developing third world countries. Gold and silver are projected to provide the positive growth shown for the metal mining sector.

Increased coal production will be limited by low prices and excess capacity world wide. Metallurgical (coking) coal is particularly in an over supply position. Thermal coal has a better long term outlook and is expected to supply positive growth to the sector.

2.4.3 The Manufacturing Sector (Figure 2.8).

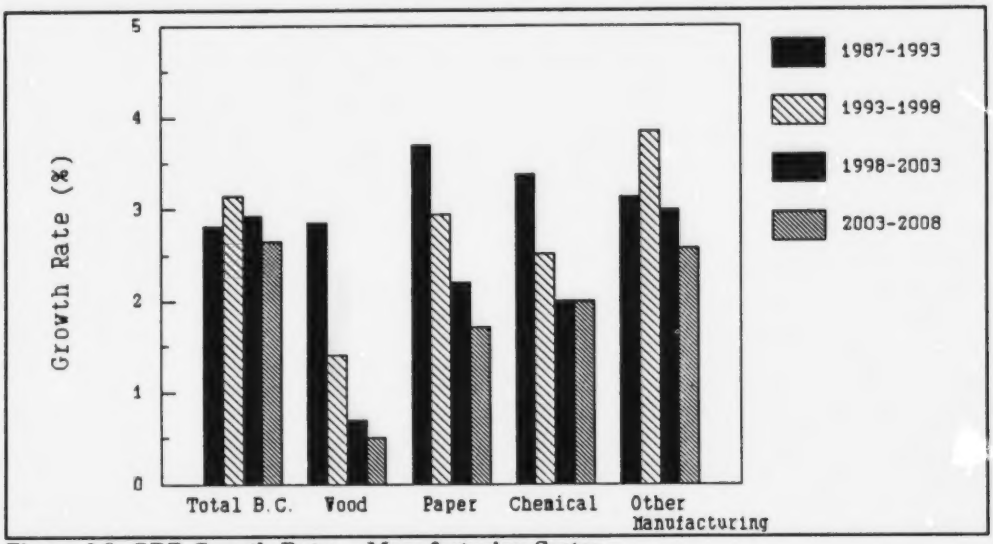


Figure 2.8: GDP Growth Rates - Manufacturing Sector

Wood products is B.C.'s most important manufacturing industry and will remain very prominent. Its relative importance will decrease, however, as long term growth is limited by timber availability. Positive growth will result from better utilization of raw material plus increased production of higher valued products.

Pulp and paper manufacturing is projected to eventually replace wood manufacturing as the most important manufacturing sector. Technological advances, particularly in mechanical pulping, are allowing for more and better use of existing raw material and for use of different wood species such as aspen. The present mechanical pulp production and paper expansions are projected to be the future trend as well. A trend to higher valued paper products is also expected. Long-term growth is thus expected to be higher than for wood manufacturing but eventually also reach the limitation of available resource.

The portion of the chemical industry associated with the pulp and paper industry is primarily for the kraft pulp sector (where little growth is expected) and is very electric intensive. Mechanical pulping requires few chemicals and thus growth of the chemical sector is limited in this area. Lower projected electricity prices in B.C. than for many other areas in North America, however, give the industry scope for developing new markets.

Contained in the other (remainder of) manufacturing are such as primary metals, petroleum products, food and beverage and other non-resource based manufacturing. In primary metals, the smelting industry has considerable potential for growth in such as aluminum, lead/zinc, copper, silicon, chromium, etc. Non-resource based manufacturing is projected to be the industrial sector with the most rapid growth throughout the period with the main growth expected to be in the high technology industries.

2.4.4 The Construction Sector (Figure 2.9).

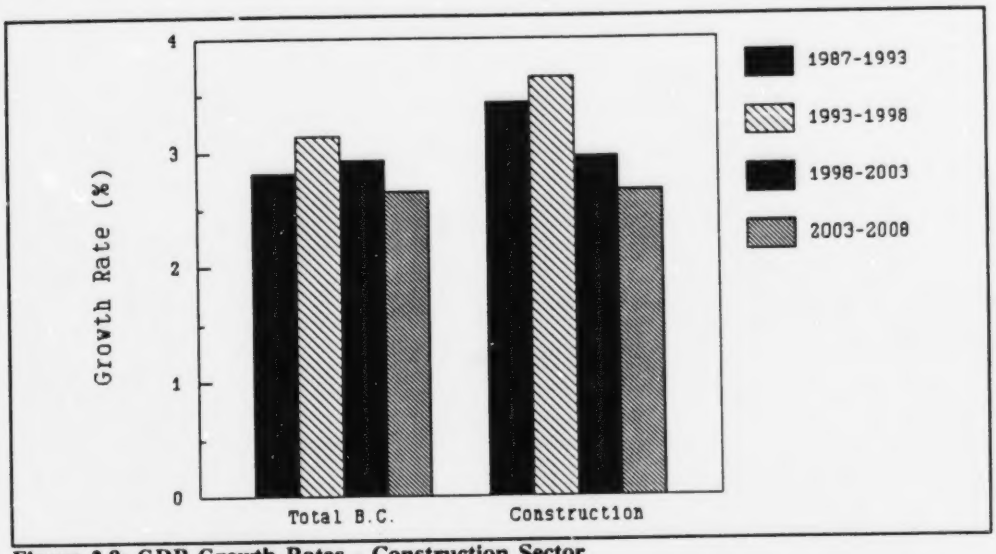


Figure 2.9: GDP Growth Rates - Construction Sector

Construction is expected to grow marginally faster than total GDP, especially through the first half of the forecast period.

2.4.5 The Commercial Sector (Figure 2.10).

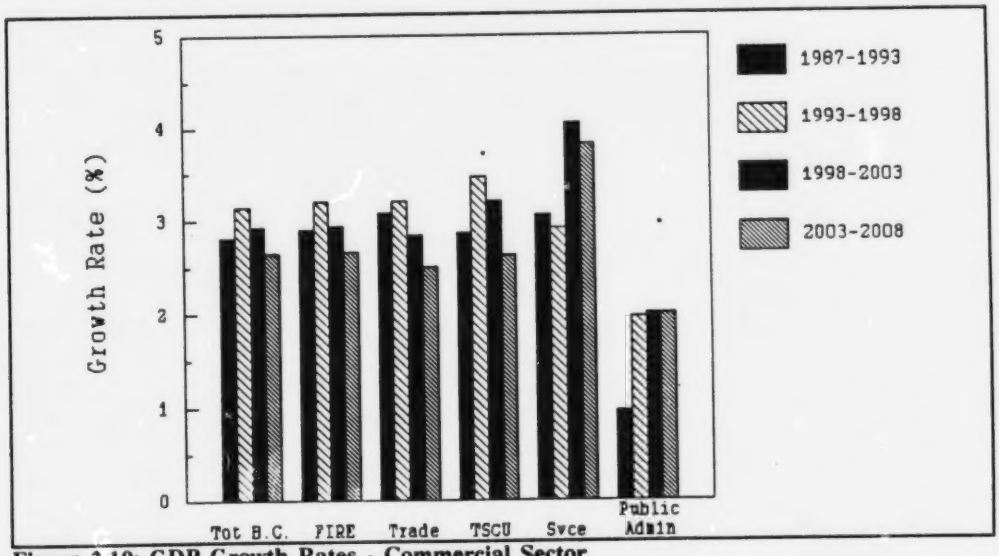


Figure 2.10: GDP Growth Rates - Commercial Sector

Within the commercial sector, community, business and personal services (Svce) is projected to have the highest long-term growth rate and in fact the highest growth rate of all sectors. Tourism, along with personal and business services, are expected to be the main growth areas within this sector.

With the increasing importance of external trade to B.C.'s economy, the transportation, storage and communications (TSCU) sector is also projected to enjoy a high growth rate.

2.5 ALTERNATIVE ECONOMIC SCENARIOS

In addition to the forecast probable economic scenario as discussed in Section 2.2, The Ministry of Finance and Corporate Relations also provided low and high economic forecast scenarios.

The **low scenario** assumes Japan and West Germany are not able to adapt to the massive appreciation of their currencies; U.S. trade deficit shows no marked improvement; and the free trade agreement would be shelved indefinitely. All sectors, except agriculture, of the B.C. economy would be adversely affected. It would not be until late 1990 that B.C. would return to moderate economic growth under this scenario.

The **high scenario** assumes Japan and West Germany successfully implement strong reflationary policies; U.S. trade deficits are quickly reduced; and the free trade agreement would be successfully implemented. As a result strong economic growth starts in 1989, and lasts until the end of the forecast, when growth slows to more moderate levels.

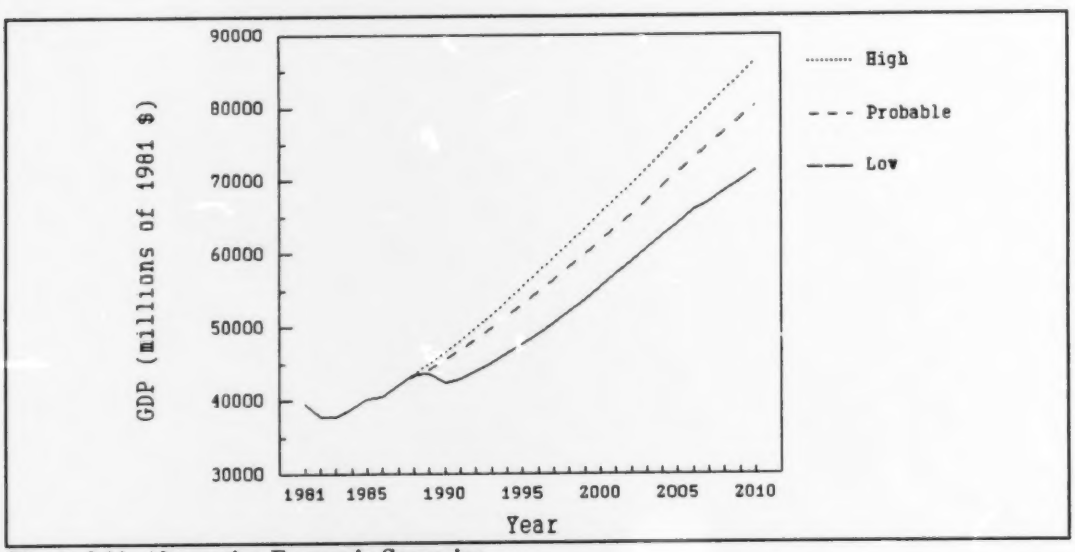


Figure 2.11: Alternative Economic Scenarios

2.6 ENERGY PRICES

The **electricity price** forecast is based on future revenue requirements which depend on both the cost of existing and additional plant needed to meet load growth as well as other factors such as taxes, export revenues from surplus sales and financial charges. This year's projection for electricity prices is a decline in real terms of 1.5% per year for the first 10 years and remaining flat in real terms (i.e. increases at the rate of inflation) thereafter. The result by 1998 is a real price decline of approximately 14%.

The perspective for **crude oil price** in the long term remains uncertain. However, equilibrium levels of long-term crude oil prices are projected to fall between U.S. $15 and $20 per barrel (1988$). Crude oil prices below or above this range will impact supply and demand in a manner which will return

prices to the US $15 to $20 per barrel range. For this forecast, oil price are assumed to remain flat, in real terms, for 5 years and then increase at 1% per year.

The **natural gas prices** will be a function of both market forces and the resolution of industry constraints. In the long term natural gas prices are expected to increase relative to crude oil prices. The fundamental reason for the relative price rise is that North American natural gas markets will tighten before world crude oil markets tighten because the world crude oil production surplus is considerably greater than the North American gas deliverability surplus. The wellhead price is thus expected to begin rising significantly in real terms. Distribution costs, however, are expected to remain constant. The result assumed for this forecast is an overall increase of 1.25% per year in real terms.

The long-term effect of the outlook for electricity, crude oil and natural gas price is illustrated for the residential sector in Figure 2.12. The graph shows efficiency adjusted costs for residential heating fuels with present Lower Mainland prices used. Light fuel oil and natural gas are expected to remain close to the same relative position. Electricity, however, will become relatively cheaper but not to the point of being competitive with natural gas. Thus no significant change in the pattern of fuel use is projected. This same outlook is assumed for the competitive areas within the commercial and industrial sectors.

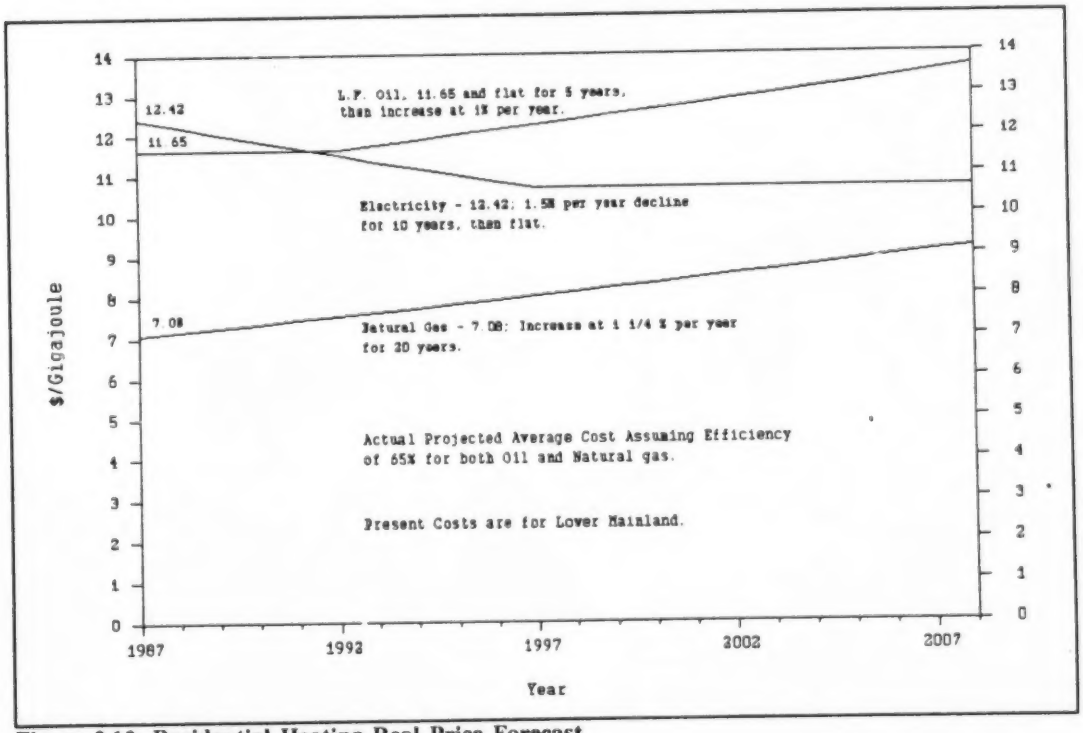


Figure 2.12: Residential Heating Real Price Forecast

SECTION 3 - PROBABLE ELECTRIC FORECAST

The Probable Electric Forecast, as described in this section, encompasses B.C. Hydro's integrated and non-integrated (primarily diesel generation) areas plus firm export and inter-utility commitments. As such firm sales to West Kootenay Power and Light and Seattle City Light (under the Skagit agreement) as well as Point Roberts and Hyder in the U.S. and to Alberta Power in the Peace River are included. Excluded are out of Province interruptible sales.

As well, the Interruptible Marketing (E+) and Demand Side Management (Power Smart) programs are not included in the forecast. They are discussed in Section 5 and must be subtracted or added to arrive at the forecast required for a particular planning consideration. They are omitted here primarily because of the interruptible nature of the E+ programs and the use of the Power Smart programs as energy sources by Resource Planning.

The Forecast is prepared in detail, i.e. on a year-by-year basis for the first 10 years (through 1998/99). The following 10 years (through 2008/09) rely on trend projections tied to the long-term economic outlook. With no specific timing of projects assumed. The discussion in this section deals primarily with the first 10 years of the forecast.

3.1 1988 PROBABLE FORECAST

Total gross requirements are projected to increase from 40,793 GW.h in 1987/88 to 55,290 GW.h in 1998/99 and 72,410 GW.h in 2008/09 for an annual average growth rate for the 20-year period of 2.8%. Table 3.1 provides details of the projections by the major forecast components (sectors). Figure 3.1 provides a graphical representation for key years.

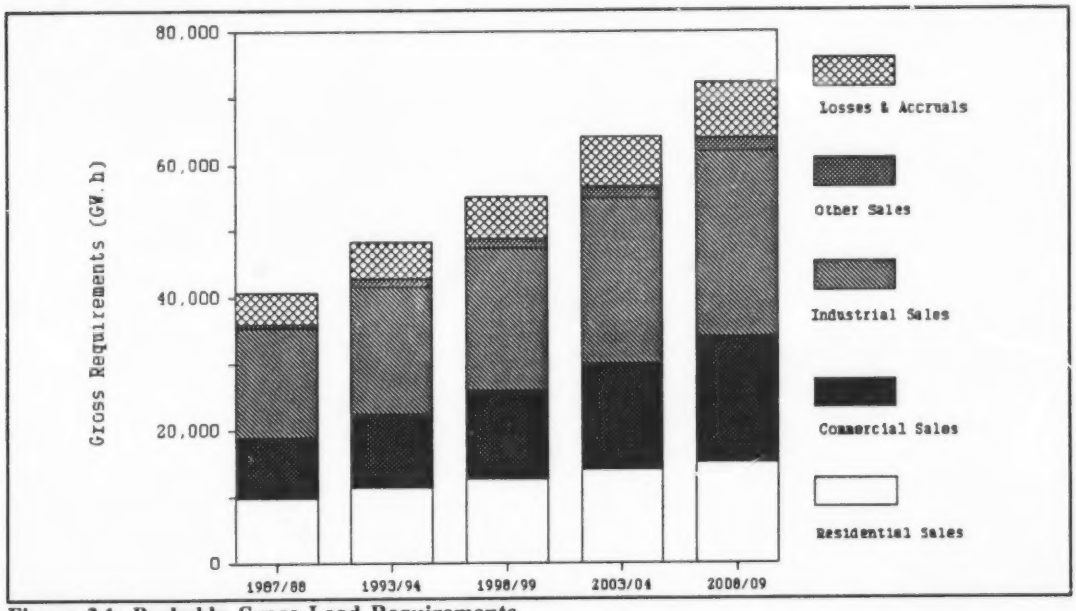


Figure 3.1: Probable Gross Load Requirements

Table 3.1
B.C. HYDRO PROBABLE GROSS LOAD REQUIREMENTS BY MAJOR SECTORS
(Including SCL & WKP&L)

Fiscal Year	Residential Sales (GW.h)	Commercial Sales (GW.h)	Industrial Sales (GW.h)	Other Sales (GW.h) (1)	Total Sales (GW.h) (2)	Losses/ Accruals (GW.h)	TOTAL GROSS REQT'S. (GW.h)	Less Non-Integr. (GW.h)	Integr. TOTAL GROSS REQT'S. (GW.h)	System Peak (MW)
Actual										
1985/86	9793	8315	14571	456	33135	4292	37427	166	37261	6816
1986/87	9666	8678	15365	622	34331	3992	38306	167	38139	6577
1987/88	9902	9060	16427	679	36068	4725	40793	167	40626	7060
Forecast										
1988/89	10298	9478	17010	705	37491	4830	42320	170	42150	7540
1989/90	10530	9688	17845	768	38831	4980	43810	180	43630	7640
1990/91	10763	9996	18379	751	39889	5110	45000	180	44820	7830
1991/92	10995	10296	18705	1036	41032	5270	46300	190	46110	8080
1992/93	11219	10646	18840	1088	41793	5390	47180	190	46990	8230
1993/94	11451	11029	19269	1135	42884	5540	48420	200	48220	8450
1994/95	11691	11445	19689	1196	44021	5690	49710	210	49500	8680
1995/96	11922	11896	20145	1261	45224	5850	51070	210	50860	8910
1996/97	12142	12362	20449	1333	46286	6000	52280	220	52060	9130
1997/98	12356	12850	20919	1390	47515	6170	53680	230	53450	9390
1998/99	12576	13355	21562	1455	48948	6350	55290	230	55060	9670
Avg. Ann.% incr. 11 years:										
87/88-98/99	2.2%	3.6%	2.5%	7.2%	2.8%	2.7%	2.8%	3.0%	2.8%	2.9%
1999/2000	12854	13873	22266	1454	50448	6540	56980	240	56740	9960
2000/01	13153	14409	22971	1524	52057	6740	58800	260	58540	10280
2001/02	13529	14963	23679	1591	53761	6960	60720	260	60460	10600
2002/03	13780	15532	24339	1658	55309	7160	62470	270	62200	10910
2003/04	14035	16112	25000	1732	56880	7370	64250	280	63970	11220
2004/05	14282	16708	25663	1806	58459	7570	66030	290	65740	11530
2005/06	14508	17315	26278	1875	59976	7770	67750	300	67450	11840
2006/07	14701	17931	26895	1931	61457	7960	69420	310	69110	12120
2007/08	14865	18547	27444	1985	62841	8140	70980	310	70670	12390
2008/09	15024	19165	27865	2039	64093	8320	72410	320	72090	12650
Avg. Ann.% incr. 10 years:										
98/99-08/09	1.8%	3.7%	2.6%	3.4%	2.7%	2.7%	2.7%	3.4%	2.7%	2.7%
21 years:										
87/88-08/09	2.0%	3.6%	2.5%	5.4%	2.8%	2.7%	2.8%	3.1%	2.8%	2.8%

Notes:

1. Inter-Utility transfers (including WKP&L) and firm export (including SCL).
2. Interruptible Marketing (E+) and Demand Side Management (DSM) programs not included.

Residential sales are projected to be the slowest growth sector. The continuing efficiency improvements in appliances and the high saturation of (and limited introduction of new) electric intensive appliances are the primary reasons for the conservative growth projections.

Commercial sales are projected to grow faster than both the other major sectors of residential and industrial. The driving factor is the continuing addition of (relatively) new applications such as office automation, personal computers, etc. The result is a continuing increase in use of electricity by existing customers.

Industrial sales growth is projected to be driven by the pulp and paper sector through the early 2000's when resource availability will limit growth. Mining load is expected to show negative growth with closure of many existing copper mines in the 1990's. New sales are anticipated from the area of smelting, chemicals and new manufacturing. An additional driving factor is the continuing trend to improving productivity via the increased use of electricity.

Figure 3.2 compares the projected growth rates of the residential, commercial and industrial sectors.

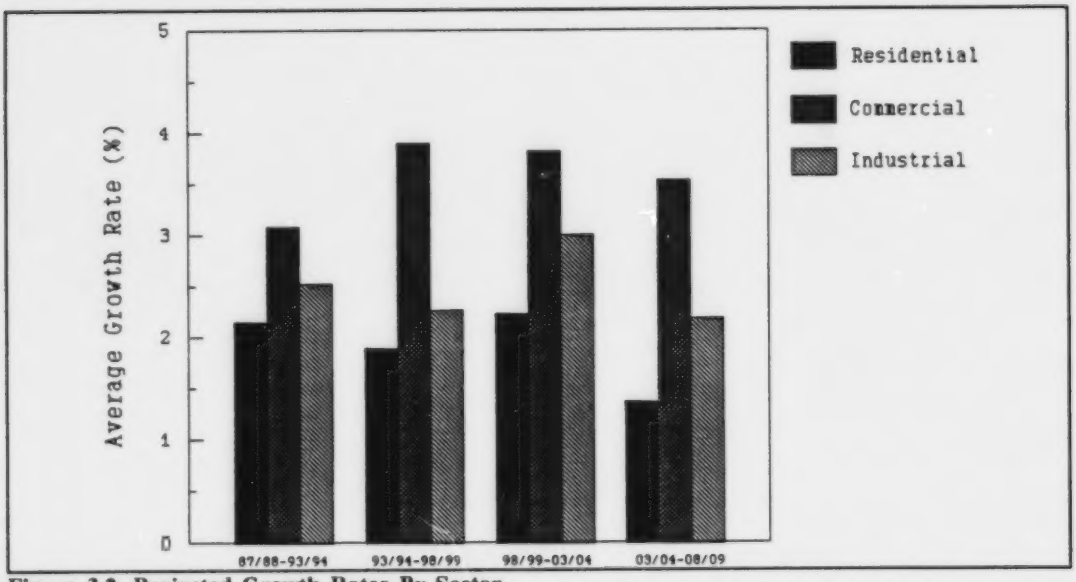


Figure 3.2: Projected Growth Rates By Sector

The Other sales sector exhibits a high projected growth rate due to a significant increase in requirements for West Kootenay Power and Light (see Section 3.6).

The peak demand (in MW) shown is for the integrated system since most planning functions consider the peak at this level. The growth in peak demand is expected to closely parallel the growth in energy requirements. No discernible change in the annual system load factor is evident from recent history. Influences will come, however, from changing load patterns due to Demand Side Management programs and continuous monitoring will be necessary.

Existing load and projected growth to 1998/99 by B.C. Hydro's four Divisions is shown in Figure 3.3. The Lower Mainland presently accounts for 46% of the total load. With the highest projected Divisional growth rate at 3.3%, this share is expected to increase to 48% by 1998/99. The lower growth rates in the other Divisions reflect marginally lower population projections and expected closures of copper mines with the South Interior in particular being affected. Another factor is the geographic location of the electric intensive pulp and paper load being added.

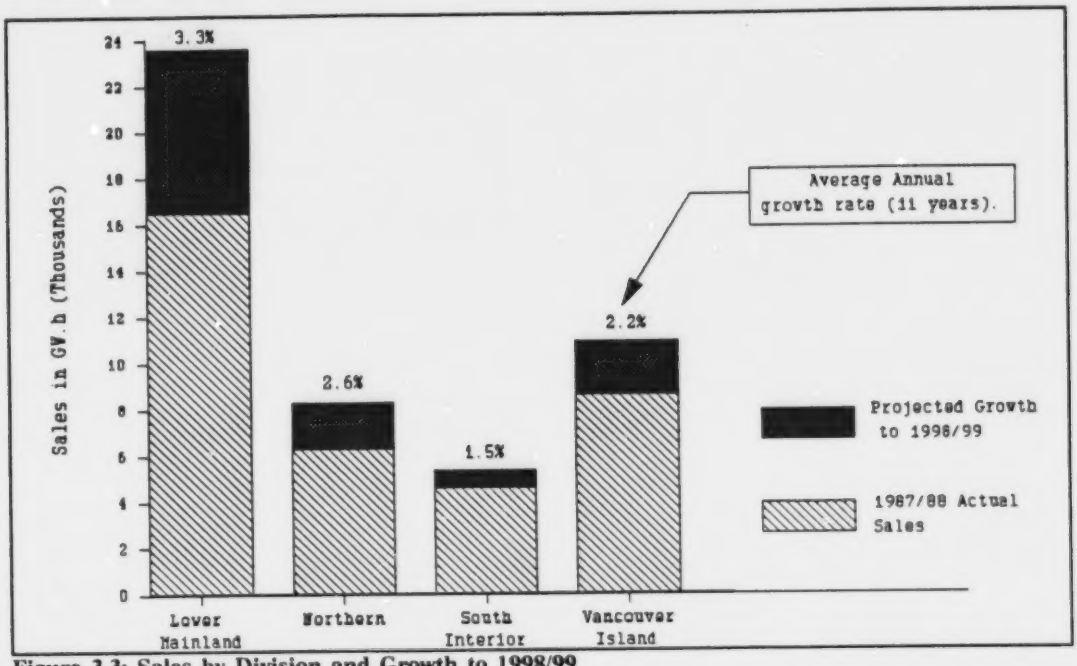


Figure 3.3: Sales by Division and Growth to 1998/99

3.2 FORECAST DRIVERS

The population and economic forecasts (total and sectoral GDP) are related directly to the various sectoral sales projections as illustrated in the following. The energy price forecasts are used to adjust particular electricity use intensity based on the scope customers have for changing their usage patterns and how they are likely to react to changes in real and relative electricity prices.

Residential sales growth depends on account growth which in turn is population driven as illustrated in Figure 3.4. The higher growth rate for accounts (than population) reflects the declining ratio of people per household. The narrowing of the gap in recent years shows that rate of decline is slowing.

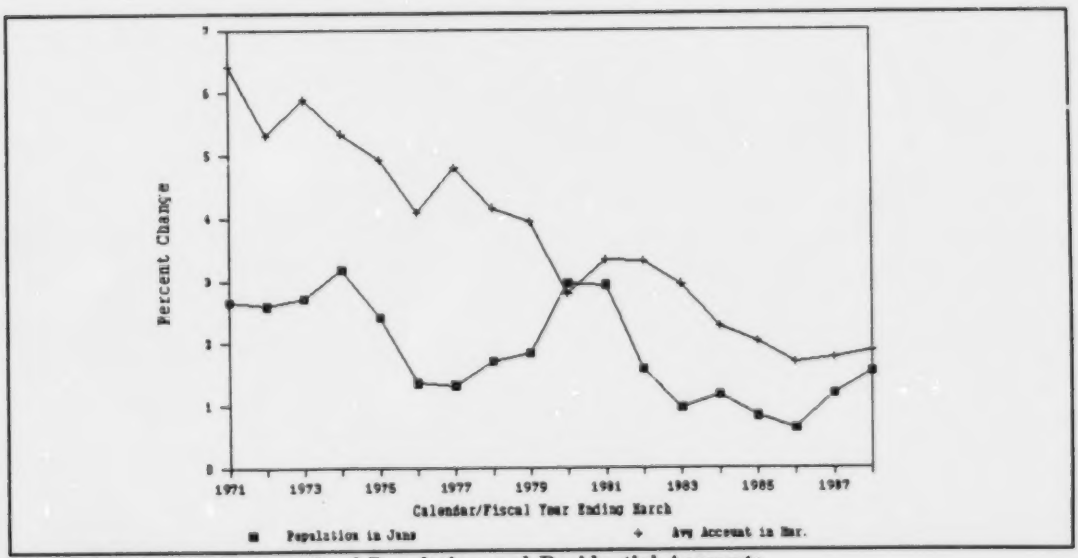


Figure 3.4: Annual % Growth of Population and Residential Accounts

Commercial sales growth is driven by the commercial sector GDP as illustrated in Figure 3.5. Since 1983 a 1% growth in commercial sector GDP has resulted, on average, in a 1.8% growth in commercial sales. Sectoral electric sales data previous to 1983 is not reliable thus the limited historical comparison.

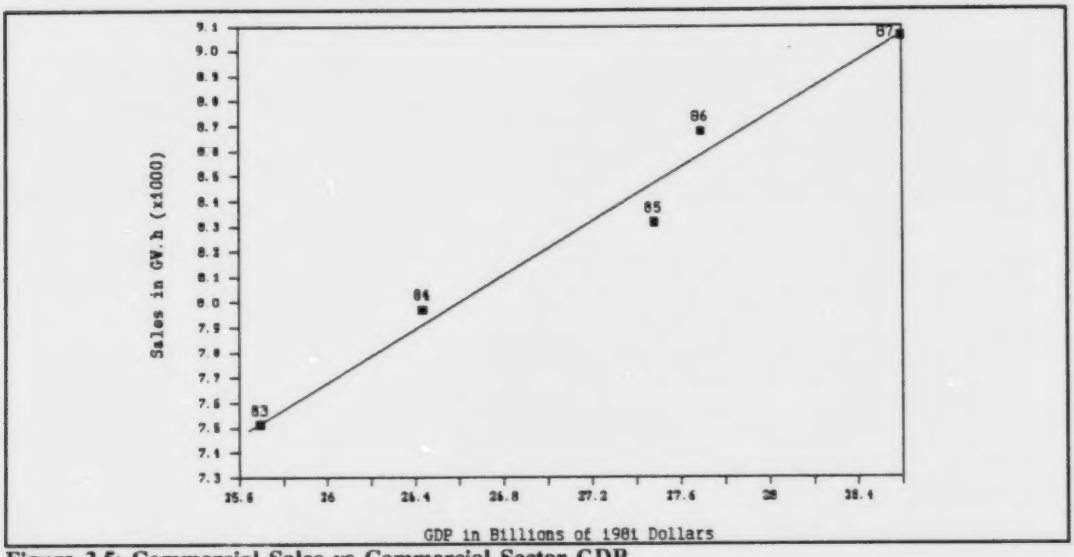


Figure 3.5: Commercial Sales vs Commercial Sector GDP

Industrial Sales growth is driven by the industrial sector GDP as illustrated in Figure 3.6. Since 1982 a 1% growth in industrial sector GDP has resulted, on average, in a 1.7% growth in industrial sales which is a very similar relationship to the commercial sector.

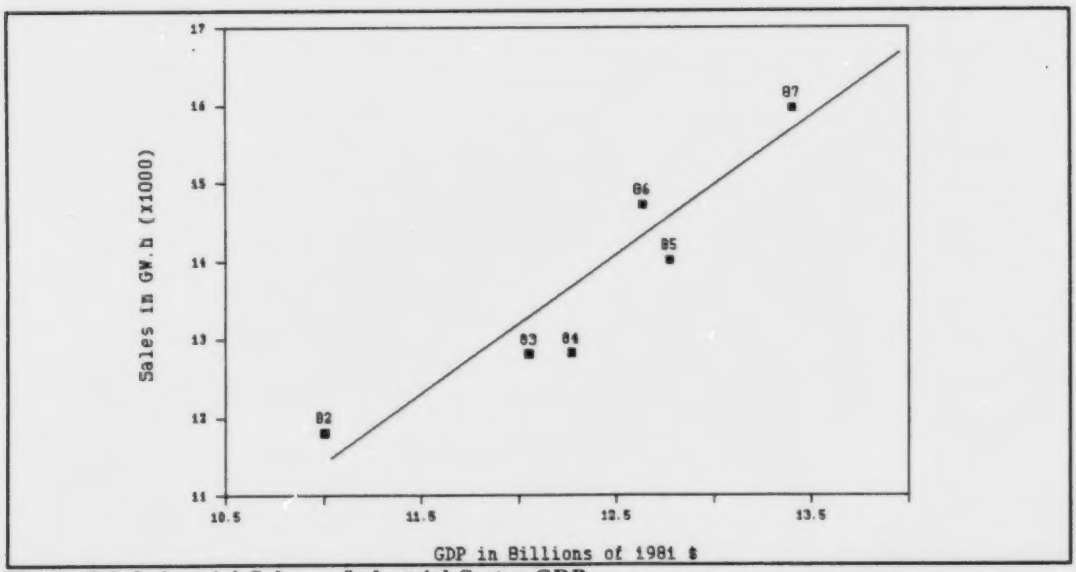


Figure 3.6: Industrial Sales vs Industrial Sector GDP

Electric intensity in kWh/$GDP in the industrial sector is higher than that in the commercial sector. Within the industrial sector, considerable variation in electric intensity also exists. Figure 3.7 illustrates this relative electric intensity for the base year of 1987/88. The industrial sales forecast is thus done in more detail (at a sectoral level), than the commercial sales forecast.

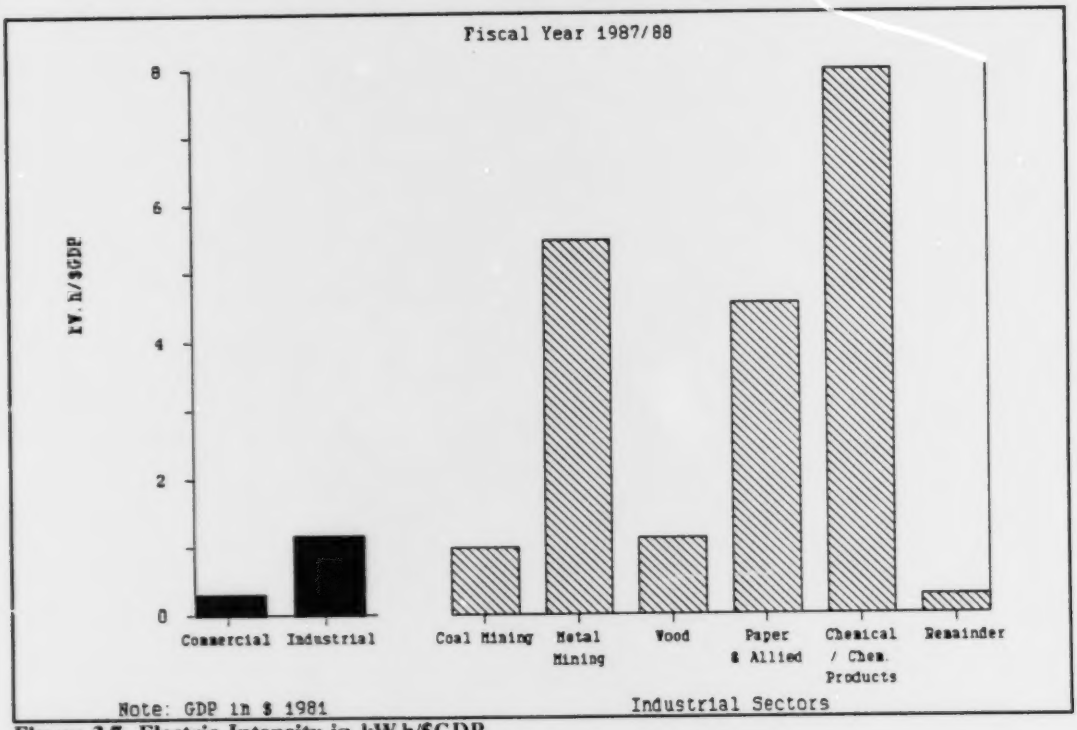


Figure 3.7: Electric Intensity in kW.h/$GDP

Electricity cost as a percentage of product selling price is an indication of how critical electricity prices are to a given industrial sector. In mid 1988, the following approximate relationships existed in B.C.:

Product	Electricity Cost as a % of Product Selling Price
Newsprint	8.0
Pulp	
- Bleached Softwood Kraft	2.5
- Chemi-thermal Mechanical	10.5
Lumber	
- SPF 2x4's	2.0
Copper (@ $1.10 U.S. per lb)	4.5 to 11.0 (varies by mine)
Coal	1.5
Chemicals	
- Sodium Chlorate	~ 30.0

3.3 RESIDENTIAL SALES

In the fiscal year ending March 31 1988, residential sector sales amounted to 9,892 GW.h and accounted for just under 28% of B.C. Hydro's total billed sales. Residential sales are forecast to increase from 9,892 GW.h in 1987/88 to 12,576 GW.h in 1998/99, representing an average annual growth rate of 2.2%. Continued growth in residential sales will be affected to a large extent by factors such as population increase, rate and type of household formation, the share of accounts using electricity for space heating and the penetration rate of energy efficiency improvements. Details of the projections are provided in Table 3.2 below.

Table 3.2
RESIDENTIAL ELECTRIC SALES FORECAST
(Billed Basis, No Adjustment For Accrual)

Fiscal Year	Average Residential Accounts (000)	Percent Electric Heating (%)	Annual Average Use Per Account: Non-Electric Heating (kW.h)	Electric Heating (kW.h)	All Accounts (kW.h)	Total Sales (GW.h)
1977/78 (Actual)	815.3	8.3	7,659	19,557	8,649	7,051
1986/87 (Actual)	1,033.6	18.2	8,299	14,068	9,351	9,665
1987/88 (Actual)	1,052.9	18.7	8,344	13,946	9,395	9,892
Avg. Annual Growth (%) 10 years:						
77/78 - 87/88	2.6%	11.3%	0.9%	-3.3%	0.8%	3.4%
FORECAST						
1988/89	1,073.6	19.3	8,427	14,470	9,592	10,298
1989/90	1,095.4	19.7	8,433	14,406	9,613	10,530
1990/91	1,116.6	20.2	8,444	14,362	9,640	10,763
1991/92	1,137.7	20.7	8,458	14,292	9,664	10,995
1992/93	1,158.3	21.1	8,472	14,217	9,686	11,219
1993/94	1,179.1	21.6	8,491	14,150	9,712	11,451
1994/95	1,200.6	22.0	8,508	14,095	9,738	11,691
1995/96	1,222.8	22.5	8,514	14,014	9,750	11,922
1996/97	1,245.7	22.9	8,516	13,888	9,747	12,142
1997/98	1,268.9	23.4	8,517	13,741	9,738	12,356
1998/99	1,292.3	23.8	8,519	13,611	9,731	12,576
Avg. Annual Growth (%) 11 years:						
87/88 - 98/99	1.9%	4.1%	0.2%	-0.2%	0.3%	2.2%

In projecting the number of residential accounts, age specific headship rates and dwelling preference factors are applied to the population forecast to distribute households by type of dwelling. B.C. Hydro's 1987/88 fiscal year average number of residential accounts of 1,052,943 is projected to increase to 1,292,340 by 1998/99, an annual growth rate of 1.9% per year.

The use of electricity for space heating continues to play an important role in the determination of residential load growth. In developing the forecast for the number of residential customers with electric space heating, the short term is based almost exclusively on regional information. The longer term is influenced by factors such as relative energy prices, builder preferences (particularly with regard to equipment and installation costs), government programs and support, the changing housing mix and the natural gas pipeline to Vancouver Island. By 1998/99 the share of residential accounts with electric space heating is estimated to rise from 18.7 percent to 23.8 percent (Figure 3.8).

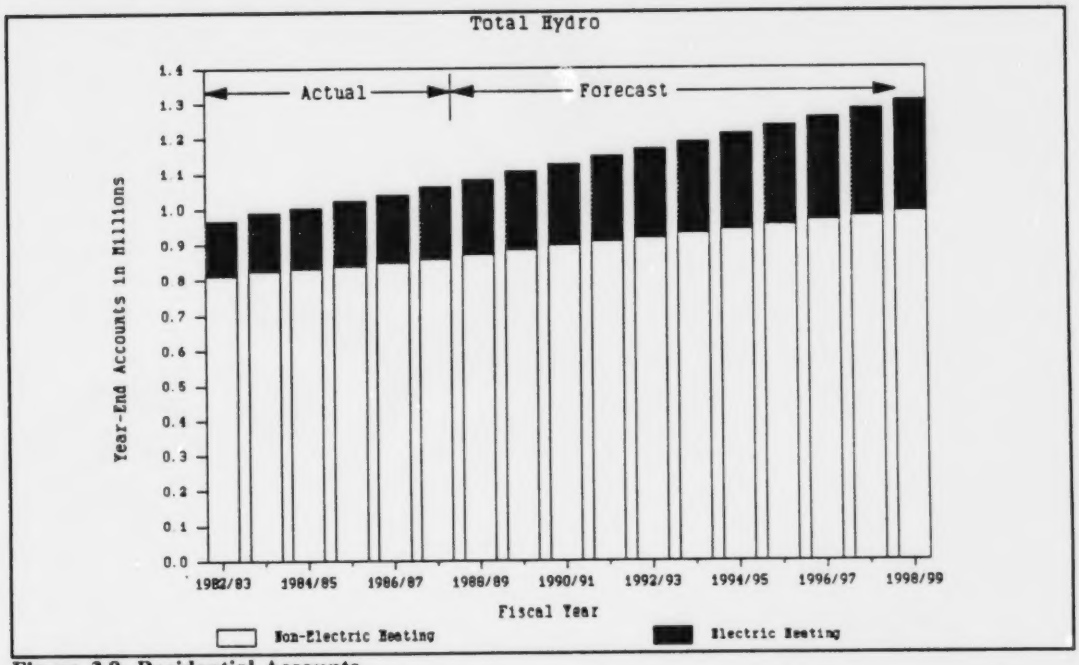


Figure 3.8: Residential Accounts

Average annual consumption for non-electric space heating accounts is largely a function of household appliances and is starting to level out. This is due to improved appliance efficiencies and the approaching saturation of many appliances. Further conservation improvements are not seen to be as great as in the past as lower real electricity prices will not encourage extensive additional conservation projects. Non-heating average annual use is forecast to increase from the current 8,344 kW.h per year to 8,519 kW.h per year by 1998. Impacts of Power Smart programs could influence this trend.

Average use for space heating accounts has been declining steadily each year on a weather normalized basis. Increasing penetration of wood stoves and their level of use has contributed to that effect. In this forecast average use for space heating accounts is expected to continue to decline. This is a result of more efficient appliances; new electrically heated houses which are better insulated; and a trend away from single family dwelling towards smaller apartments and row houses.

Figure 3.9 illustrates the sales forecast by non-heating/heating accounts.

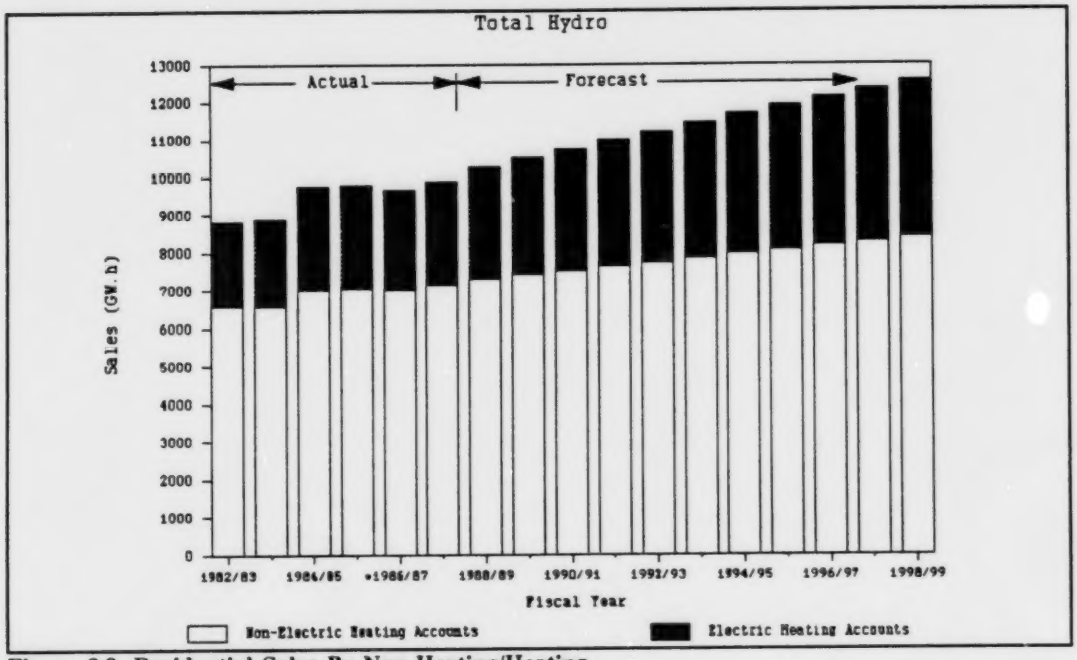


Figure 3.9: Residential Sales By Non-Heating/Heating

3.4 COMMERCIAL SALES

Sales to the Commercial Sector are forecast to grow from 9,060 GW.h in 1987/88 to 13,355 GW.h in 1998/99 for an average annual growth rate of 3.6% per year. The commercial sector share of sales will increase from 25% to 27%. See Table 3.3 which details the commercial forecast.

Table 3.3
COMMERCIAL ELECTRIC SALES FORECAST
(Billed Basis, No Adjustment For Accrual)

Fiscal Year	By Standard Industrial Classification (SIC) Transportation Communication & Other Utilities (GW.h)	Wholesale & Retail Trade (GW.h)	Finance, Insurance & Real Estate (GW.h)	Community, Business & Pers. Serv. (GW.h)	Public Admin. & Defence (GW.h)	Unclass-ified (GW.h)	Total Sales (GW.h)
1987/88 (Actual)	1,376	2,149	1,737	3,002	678	118	9,060
FORECAST							
1988/89	1,440	2,252	1,828	3,146	690	122	9,478
1989/90	1,470	2,286	1,906	3,210	691	125	9,688
1990/91	1,508	2,367	1,974	3,320	699	128	9,996
1991/92	1,558	2,454	2,016	3,425	711	132	10,296
1992/93	1,611	2,546	2,082	3,545	725	137	10,646
1993/94	1,668	2,640	2,156	3,683	740	142	11,029
1994/95	1,732	2,737	2,236	3,835	758	147	11,445
1995/96	1,802	2,838	2,329	3,994	780	153	11,896
1996/97	1,875	2,927	2,427	4,171	803	159	12,362
1997/98	1,952	3,017	2,531	4,357	828	165	12,850
1998/99	2,034	3,110	2,631	4,554	854	172	13,355
Avg. Annual Growth (%) 11 years: 87/88 - 98/99	3.6%	3.4%	3.8%	3.9%	2.1%	3.5%	3.6%

The Commercial sector is divided into six components, they are:

- Transportation
- Trade
- Finance, Insurance and Real Estate (FIRE)
- Service (Business and Personal)
- Public Administration
- Unclassified

The service component is projected to have the highest growth rate, closely followed by the FIRE and Trade components in anticipation of the ratification and successful implementation of the free trade agreement. See Figure 3.10.

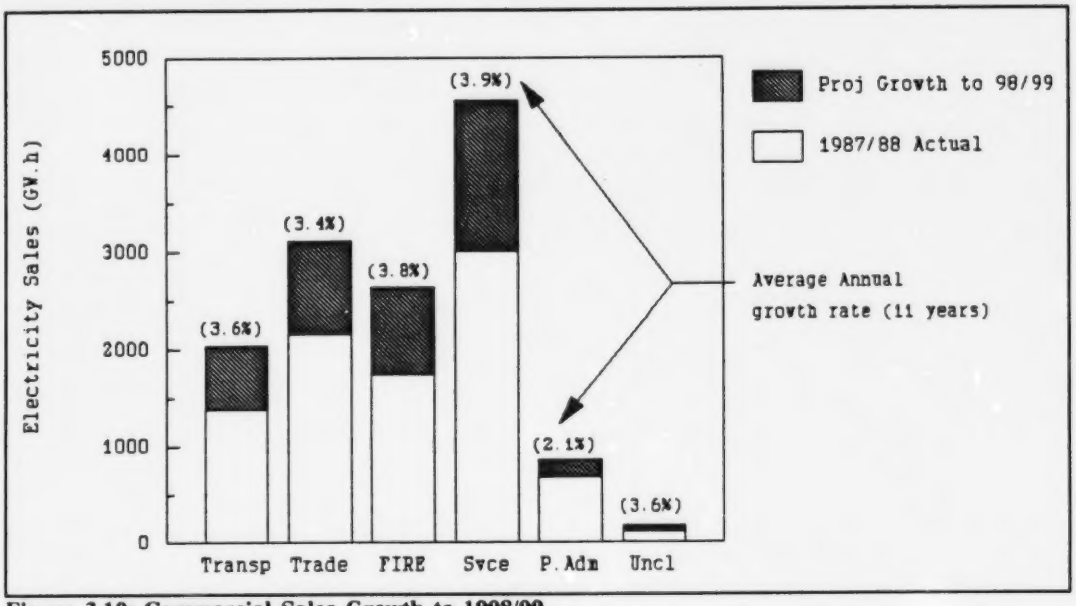


Figure 3.10: Commercial Sales Growth to 1998/99

Commercial electricity sales depends on, as a main factor, floor stock in the commercial area. Floor stock additions in 1988 continue to be strong and are estimated to be 1.86 million square meters as compared to 1.11 million square meters in 1987. However, the rate of floor stock additions is forecast to slow in 1989 and the average forecast overall stock growth is an annual addition of 1.14 million square meters through 1998.

Analysis of historical electricity consumption trend indicates that the average use declined from 1981 to 1984 and climbed marginally since 1984. It is expected that the average use rate will continue to climb due to other applications such as office automation, personal computers, etc. With declining real electricity price, the forecast increase in average annual use is an annual average of 1.8% through 1998/99.

3.5 INDUSTRIAL SALES

Sales to the industrial sector are dominated by the forest industry and related sectors (figure 3.11): paper and allied products, wood manufacturing and chemicals (produced for the pulp and paper industry). This dominance will continue to increase until wood resource availability limits growth in the early 2000's. The mining sector is currently also a major user of purchased electricity but this will decrease with the assumed decline of copper/molybdenum production in B.C.

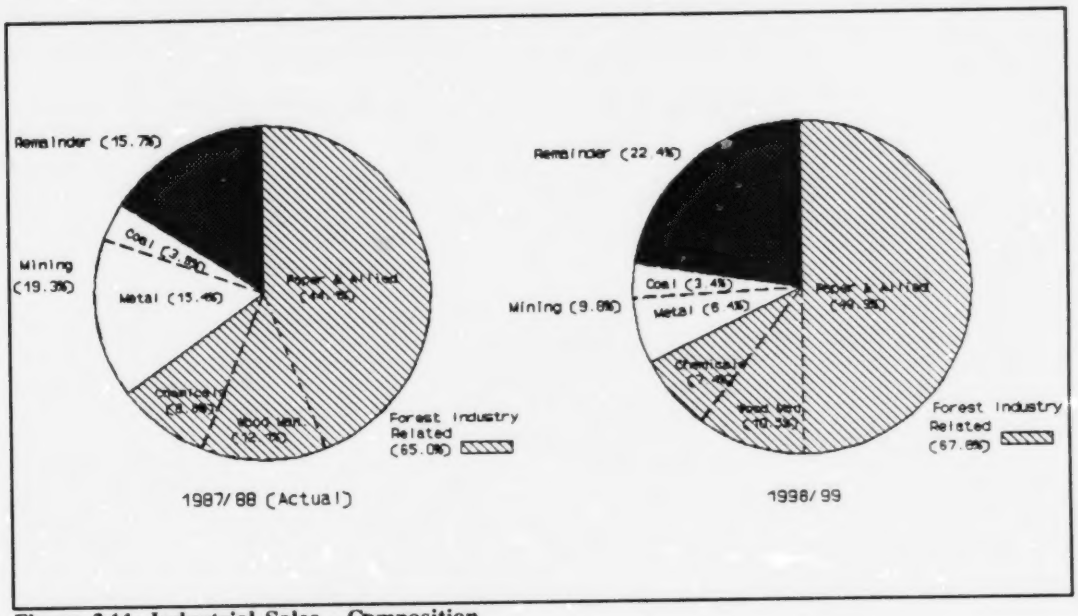


Figure 3.11: Industrial Sales - Composition

Total sales to the industrial sector are projected to increase by 5,135 GW.h between 1987/88 and 1998/99 for an average annual growth rate of 2.5%. The breakdown of sales is by Standard Industrial Classification (SIC) which correspond closely to industrial sectors in the economic forecast. Table 3.4 provides details of the forecast by the major sectors. Figure 3.12 provides a graphic comparison of sales and growth by the various sectors.

Table 3.4
INDUSTRIAL ELECTRIC SALES FORECAST
(Billed Basis - No adjustment For Accrual)

	By Standard Industrial Classification (SIC)								
	Primary Industries			Manufacturing				Const.	
Fiscal Year	Metal Mines (GW.h)	Mineral Fuels (GW.h)	Other (GW.h)	Wood (GW.h)	Paper & Allied (GW.h)	Chemicals & Prod. (GW.h)	Other (GW.h)	(GW.h)	Total (GW.h)
1987/88 Actual	2,536	757	268	1,987	7,250	1,644	1,805	180	16,427
FORECAST									
1988/89	2,584	791	273	2,033	7,611	1,745	1,788	185	17,010
1989/90	2,845	802	277	1,920	8,304	1,765	1,743	188	17,845
1990/91	2,700	817	284	1,930	8,823	1,788	1,840	196	18,379
1991/92	2,606	848	291	2,000	8,947	1,856	1,954	204	18,705
1992/93	2,391	878	298	2,060	9,110	1,877	2,014	212	18,840
1993/94	2,407	894	306	2,090	9,263	1,924	2,165	220	19,269
1994/95	2,278	894	312	2,120	9,501	1,987	2,368	229	19,689
1995/96	1,993	900	318	2,160	9,860	2,049	2,628	237	20,145
1996/97	1,624	900	325	2,190	10,163	2,111	2,890	246	20,449
1997/98	1,354	906	331	2,230	10,466	2,174	3,203	256	20,919
1998/99	1,370	906	337	2,260	10,770	2,237	3,418	264	21,562
Avg. Annual Growth: % 11 years: 87/88-98/99	-5.4%	1.6%	2.1%	1.2%	3.7%	2.8%	6.0%	3.5%	2.5%

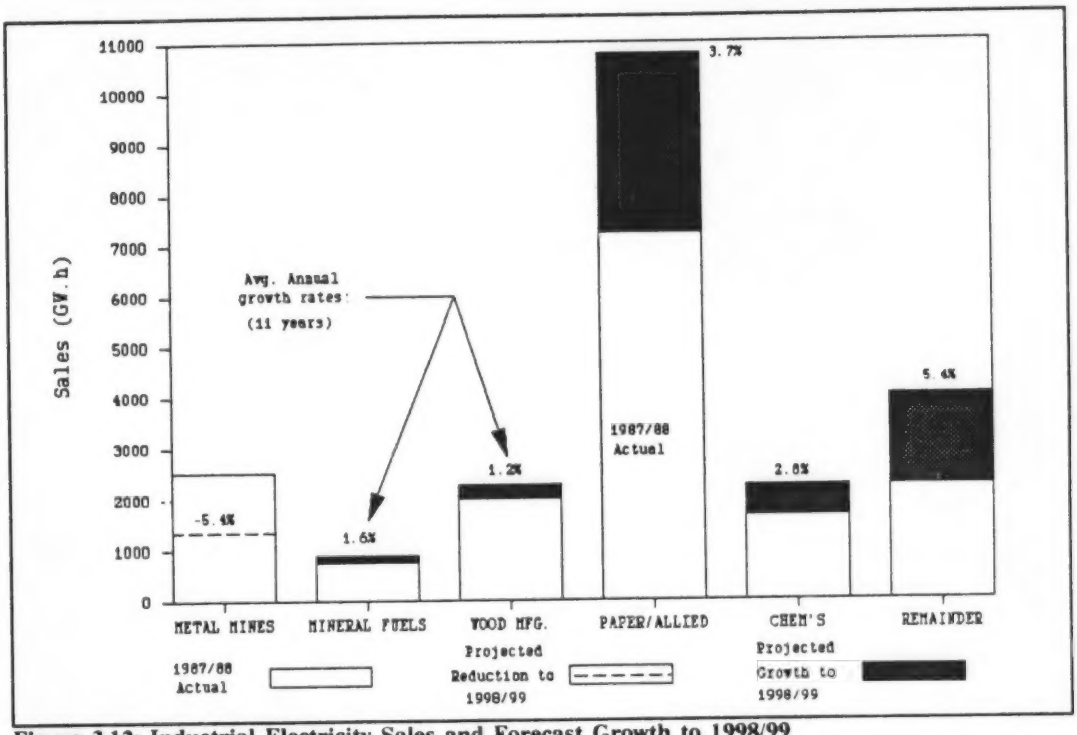


Figure 3.12: Industrial Electricity Sales and Forecast Growth to 1998/99

3.5.1 Metal Mining

The major users of electricity here are the large open pit copper and molybdenum mines. At present nine operating copper/molybdenum mines account for 99% of the sales. By the late 1990's, seven of these mines are assumed to be closed with depletion of economic ore reserves. While copper prices are currently at high levels, the long term outlook is for declining copper prices. This will preclude the likely development of any major new copper/molybdenum mines in B.C. While considerable development of gold/silver mines is anticipated, they are relatively small users of purchased electricity. The expected result is a steady decrease in electricity sales to this sector (see Figure 3.13).

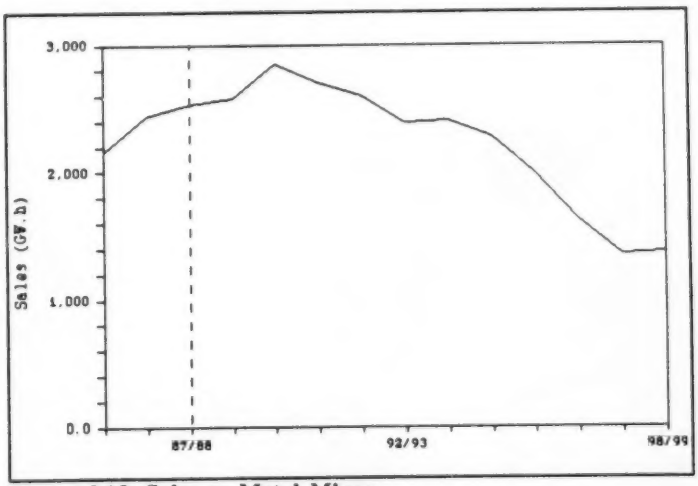


Figure 3.13: Sales to Metal Mines

3.5.2 Mineral Fuels

Contained here are coal mines and also the natural gas liquids (NGL) extraction facility in Taylor. The large, open pit coal mines (presently seven in total) account for over 80% of the load. Little change in operating levels is forecast through the period, however, one new thermal coal mine, Quinsam on Vancouver Island, is assumed to come on line, although environmental concerns still must be addressed. The NGL facility is expected to increase operating levels to maximum but no additional major loads are anticipated through 1998/99. Total sector load is shown in Figure 3.14.

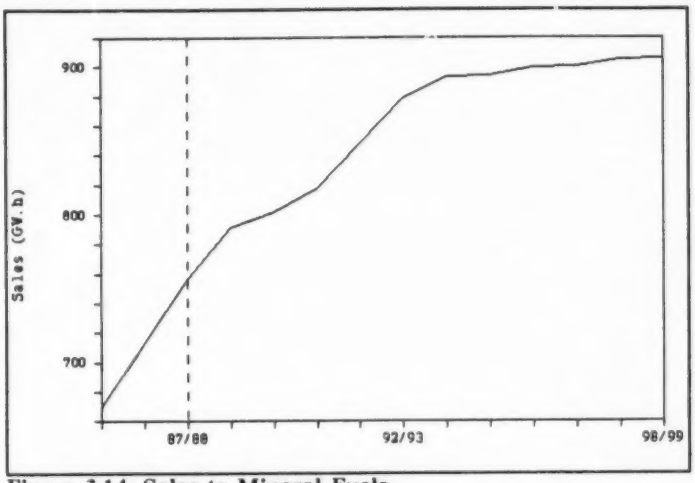


Figure 3.14: Sales to Mineral Fuels

3.5.3 Wood Manufacturing

Sales to the wood manufacturing sector (Figure 3.15) are assumed to decrease marginally over the next couple of years with the projected slowdown in the North American economy. U.S. housing starts are trending lower and this has the effect of dampening lumber prices as well as requirements. Long-term production growth is limited by the allowable annual cut. Sales growth will occur largely from technological improvements generally involving increased electricity usage, additional electric wood drying and additional value added production.

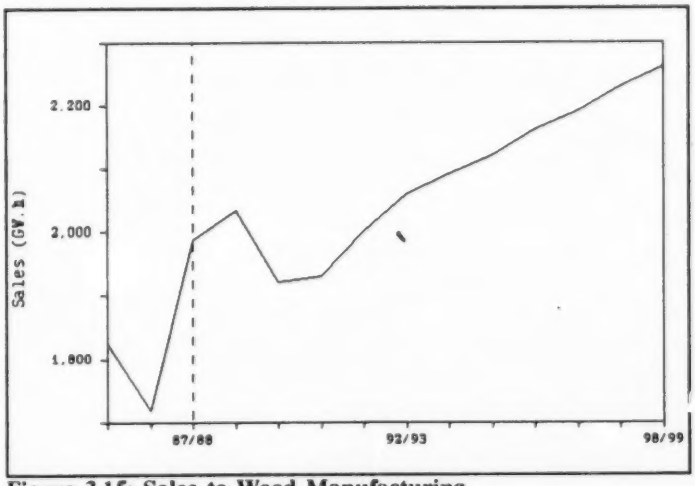


Figure 3.15: Sales to Wood Manufacturing

3.5.4 Paper and Allied Products Manufacturing

The paper and allied products sector is the largest user of purchased electricity in the industrial area. In 1987/88, the 7,250 GW.h purchased by the industry accounted for 44% of industrial sales and 20% of total sales. By 1998/99, sales are projected to be 10,770 GW.h (Figure 3.16) and account for 50% of industrial sales and 22% of total sales. Thus, the significance of the sector to B.C. Hydro is projected to further increase. It is not until after

the turn of the century, when expansion becomes limited by resource availability, that its significance will start to decrease.

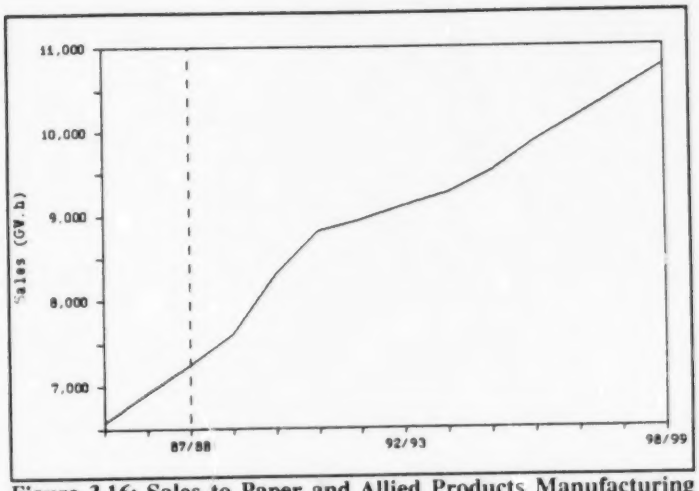


Figure 3.16: Sales to Paper and Allied Products Manufacturing

The large increase in electricity purchases is not so much due to increased production as to the pulping technologies being used. Mechanical pulp in the form of Chemi-thermal Mechanical Pulp (CTMP) is now being extensively used in new paper production in B.C. as well as being sold as a market pulp. CTMP is much more electric intensive than kraft pulp, requiring in the order of 2,200 kW.h/tonne, and its production process does not lead to new co-generation being economically installed. Kraft (market) pulp requires only approximately 800 kW.h/tonne and a considerable portion is usually supplied from co-generation.

Of the 21 customers that account for 99% of the load in this sector, nine are currently undergoing significant expansions/additions. Also, one new (greenfield) mill is being built. Between early 1988 and 1991, approximately 3,100 GW.h of new load is being added of which B.C. Hydro is projected to serve 2,500 GW.h. The major electric intensive projects, requiring 400+ GW.h/year each are, Howe Sound Pulp's kraft/CTMP/newsprint project, CIP's CTMP/newsprint project in Gold River and FIBRECO's greenfield market CTMP project in Taylor. A major portion of Howe Sound Pulp's load is expected to be co-generated.

The next cyclical expansion phase is assumed around the mid 1990's. Besides additional paper capacity at existing mills, three new greenfield mills are projected by 1998/99. The CTMP process is assumed to still dominate.

3.5.5 Chemical and Chemical Products Manufacturing

The six customers that produce chemicals mainly for the pulp and paper industry, account for 88% of sales to this sector. The production processes for sodium chlorate and chlorine/-caustic soda are very electric intensive. The other major customer in this sector is Ocelot's ammonia plant at Kitimat which accounts for another 7% of sales.

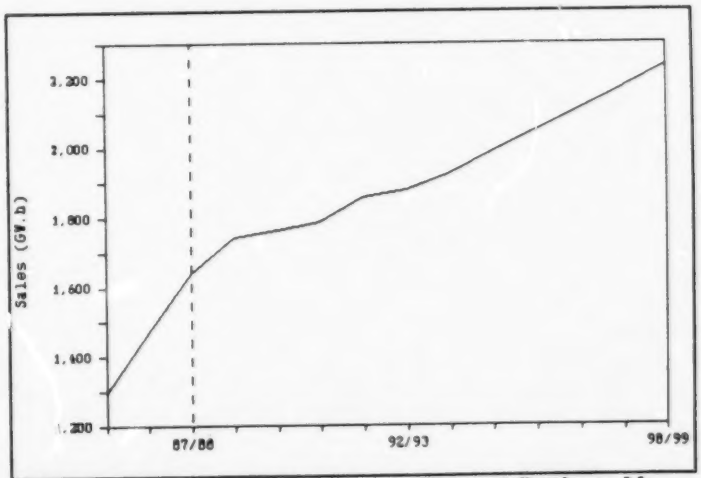


Figure 3.17: Sales to Chemicals and Chemical Products Man.

While there is limited

market potential to B.C.'s pulp and paper industry due to small chemical requirements in mechanical pulping, there is scope for developing export markets. B.C.'s electricity rates are among the most competitive in North America and are projected to remain so. With electricity in the 30% to 50% range of production costs for the chemicals presently produced, a competitive advantage exists. Some expansions or new plants are thus assumed and, in fact, FMC is building a new hydrogen peroxide (an initial use to be for bleaching CTMP) plant in Prince George.

No change is expected in operation of the ammonia plant and no natural gas associated manufacturing facilities requiring large amounts of electricity are projected through 1998/99.

Total sector sales are shown in Figure 3.17.

3.5.6 Remainder of Industrial

The industries here are, in general, smaller users of purchased electricity than the foregoing sectors. The sectors are forecast (separately) as shown in Table 3.5. Figure 3.18 illustrates the total of these remaining industrial sales.

Table 3.5
REMAINING INDUSTRIAL LOAD
SALES IN GW.h

	Other Pri Ind.	Food & Bev Man.	Pri Metal Man.	Non-Metal Min Prod Man.	Pet. & Coal Prod Man.	Misc Man.	Const. Ind.	Non Spec Load	Total
Actual									
1987/88	268	357	193	368	373	514	180	0	2,253
Forecast									
1993/94	306	416	208	400	386	654	220	100	2,690
1998/99	337	471	591	466	390	800	264	700	4,019
Avg.Annual Growth 11 years: 87/88-98/99	2.1%	2.6%	10.7%	2.2%	0.4%	4.1%	3.5%	-	5.4%

The **Primary Metal Manufacturing** sector contains smelting of which little load is presently served by B.C. Hydro. The existing aluminum and lead/zinc load is served by self-generation (Alcan and Cominco) and any additional similar load is also assumed to be supplied by other than B.C. Hydro. The additional load shown served by B.C. Hydro by 1998/99 is the assumption of a Ferrochromium smelter coming on line in the mid 1990's.

Load in the **Non-Metallic Mineral Products Manufacturing** sector is 50% to the 3 large cement plants and 25% to a fiberglass plant. Modest long term growth is projected.

The **Petroleum and Coal Products Manufacturing** sector contain the 7 major refineries which account for 95% of the load. Little growth in refinery load is anticipated and, in fact, one or more of the Lower Mainland refineries could close as they are small and relatively inefficient by present industry standards.

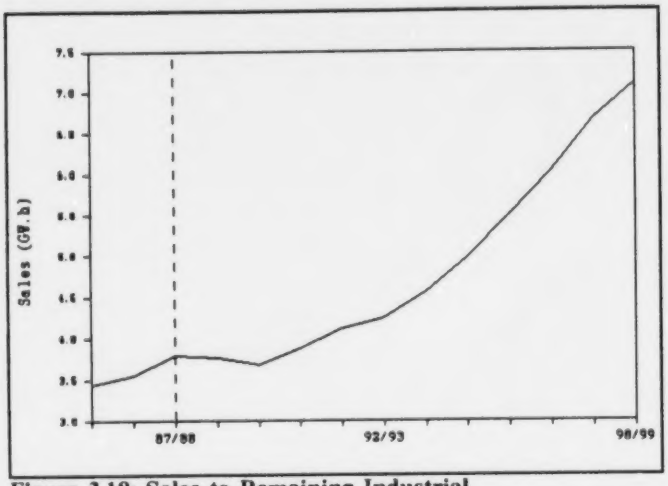


Figure 3.18: Sales to Remaining Industrial

Miscellaneous Manufacturing is largely non-resource based. While not electric intensive type load, e.g. typically high technology type industries, the growth rate is high in line with the high sectoral GDP growth rate forecast for this area.

Non Specified Load is an allowance for unanticipated new load. B.C.'s competitive electricity rates are assumed to attract investment/facilities in which electricity prices are a significant consideration.

The remaining sectors: **Other Primary Industries, Food & Beverage Manufacturing** and the **Construction Industry** contain no large customers. Growth is projected in line with the particular sectoral GDP.

3.6 OTHER SALES

Inter-utility and firm out of province sales make up the "other sales" category. See Table 3.6.

Two customers are included in inter-utility. The City of New Westminster purchases bulk and has their own distribution system. West Kootenay Power & Light (WKP&L) requirements will grow as their load increases. Their purchases include both energy associated with peaking capacity requirements and energy deficiencies anticipated. The B.C. Utilities Commission decision (in 1986) requires that WKP&L nominate annually their capacity and energy requirements from B.C.Hydro. Through 1990, a 5-year nomination is required with only the first two years binding. After 1990, a 10-year nomination is required with the first five years binding and the second five years constrained on a sliding scale from plus or minus 5% to 25% (6th through 10th years respectively).

There are 4 firm out of province contracts. Seattle City Light (SCL) sales under the Skagit agreement account for the majority of sales. They are at a set level. The other contracts are to Point Roberts in Washington, Hyder in Alaska and in the Peace River area to Alberta.

Table 3.6
OTHER SALES (GW.h)

	Inter-Utility		Firm Out of Province				TOTAL
	New West.	WKP&L	SCL	Point Roberts	Hyder	Alberta	
1987/88 (act)	275	77	311	13	trace	5	681
1998/99	375	731	318	22	trace	9	1455
Avg Annual % Growth 11 Yrs.	2.9	22.7	-	4.9	-	5.5	7.1

3.7 GROSS REQUIREMENTS AND PEAK DEMAND

Gross requirements at the generation level are obtained by adding losses to the sales estimates. Losses are based on historical trends.

Energy losses are calculated in two steps. First, distribution losses as a percent of distribution sales of 6.9% are determined. Distribution sales encompass all customers not served directly at transmission voltage (60 kV or above). Secondly, transmission losses are calculated as 8.3% of the total of distribution sales, distribution losses and transmission sales. The overall result is total losses as approximately 13% of total sales.

West Kootenay Power and Light (WKP&L) and Seattle City Light gross requirements are calculated separately. Figure 3.19 shows the build-up to total gross requirements.

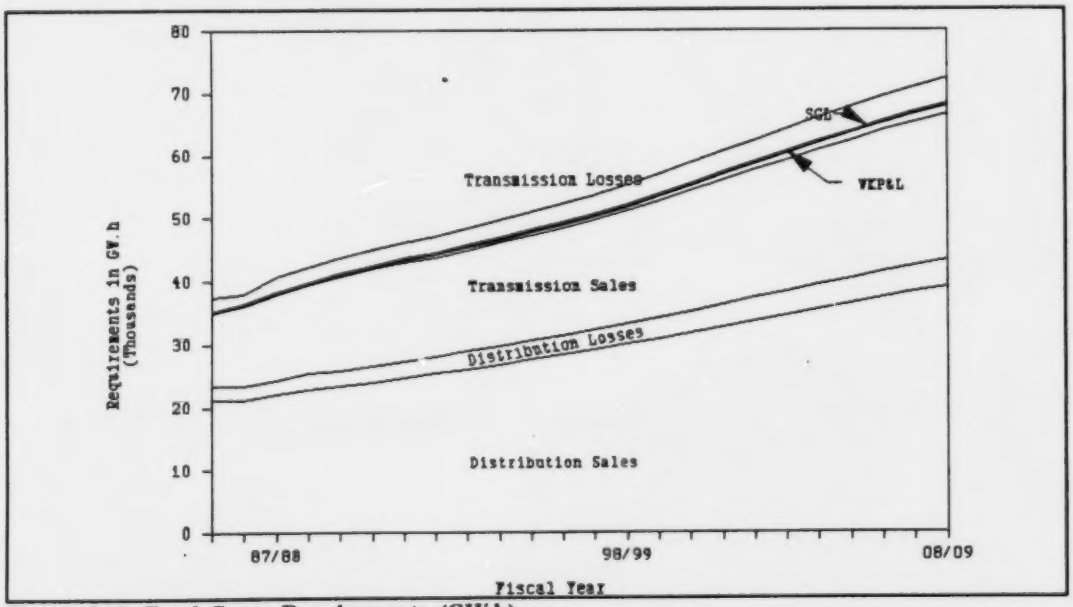


Figure 3.19: Total Gross Requirements (GW.h)

Peak demand is determined via the use of load factors that are based on historical trends.

Peak demand is calculated separately for the distribution customers and transmission customers. Distribution sales plus distribution and associated transmission losses are added and an annual load factor of 59.4% used to determine the peak contribution from distribution customers. Transmission customer sales plus associated transmission losses are added and an annual load factor of 80.0% used to determine their peak contribution. The additive result is a system load factor in the 65% to 66% range.

West Kootenay Power and Light (WKP&L) and Seattle City Light (SCL) peak impact are calculated separately.

Figure 3.20 shows the build-up to total peak demand.

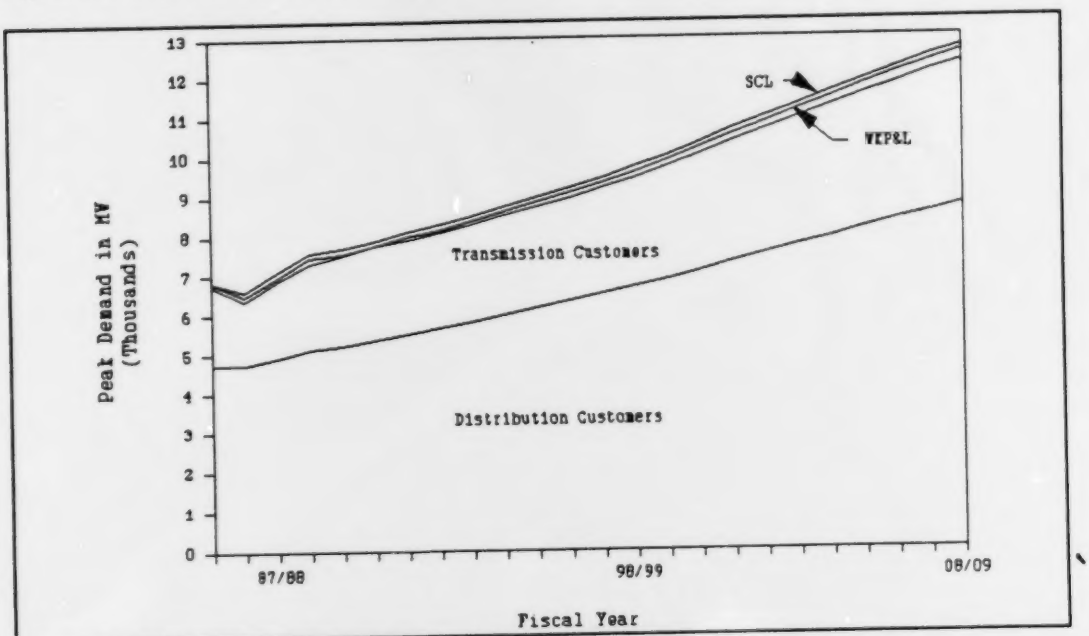


Figure 3.20: Peak Demand Composition (MW)

Projected requirements for energy deficiencies and peaking capacity are supplied by WKP&L. The SCL requirements for energy and peak capacity are per the Skagit agreement. System supply losses are added. For the peak requirements, diversity is allowed for; 95% for WKP&L and 70% for SCL. The considerable diversity for the SCL peak requirements reflects actual operation as SCL spreads out their limited energy take over an extended period of time.

SECTION 4 - ELECTRIC FORECAST UNCERTAINTY

There are two major components of uncertainty in the long term load forecast. The first is uncertainty in the future levels of major causal factors, e.g. economic conditions, energy intensity, etc, which determine the level of future electricity consumption. The second is uncertainty about the relationship between major causal factors and future electricity consumption, e.g. the relationships of economic activities and energy prices on energy consumption assumed in the present analysis may change over time.

Last year (1987), forecast uncertainty was demonstrated by developing a probability distribution around the probable load forecast, assuming provincial GDP and population growth held constant at the levels shown in the probable economic forecast. Thus, the probability distribution presented reflected uncertainties in variables such as future energy intensity and social trends but ignored the possibility of higher or lower overall economic growth. In this year's forecast the methodology was expanded to include all three economic scenarios (low, probable and high, see Section 2) thus reflecting the overall uncertainties implicit in the load forecast.

4.1 FORECAST PROBABILITY DISTRIBUTION

Uncertainty in the Gross Load Requirements Forecast has been expressed in the form of a probability distribution in two steps. The first step describes the uncertainties around the probable forecast. The second step incorporates alternate economic forecasts.

4.1.1 Probability Distribution Around Probable Forecast

This distribution describes the full range of uncertainties in the forecast by integrating the uncertainties that arise sector by sector in the probable energy forecast given that the (economic) assumptions are fixed. The uncertainties that are inherent in each sector (assuming fixed input assumptions) were assessed by assigning subjective probabilities to key causal factors in each sub-sector. An uncertainty model employing Monte Carlo simulation methods was used to quantify and combine the probability distributions. The level of breakdown and results of this analysis are summarized for 1993 and 1998 in Table 4.1 and shown graphically in Figure 4.1. Large variability is indicated by higher value of standard deviation as a percentage of mean. Variability increases substantially as the time to the forecast period increases. As an example, variability at the total system level almost doubles (3.0% to 5.6%) from 1993 to 1998. Similar probability distributions were calculated (extrapolated) for each forecast year. These distributions all assume that general economic forecasts, represented by Provincial GDP and population growth, remain unchanged.

Table 4.1
Sectoral Probability Distribution
Assuming Fixed Economic Assumptions

	Mean GW.h	Median GW.h	Standard Deviation GW.h	Standard Deviation (%)**
1993				
Industrial				
Pulp & Paper	9,230	9,230	315	3.5
Wood Products	2,115	2,095	65	3.1
Metal Mining	2,350	2,380	140	5.9
Coal Mining	715	715	40	5.6
Chemicals	1,945	1,900	140	7.2
Other Industrial	2,875	2,840	170	6.1
Industrial Total	19,230	19,160	870	4.5
Commercial				
Trade	2,650	2,640	50	2.1
Service	3,665	3,675	60	1.6
Other Commercial	4,710	4,700	70	1.4
Commercial Total	11,025	11,015	180	1.7
Residential Total	11,375	11,400	420	3.6
Losses,Accruals,& Others	6,645	6,645	-	-
System Total	48,275	48,220	1,470	3.0
1998				
Industrial				
Pulp & Paper	10,660	10,795	705	6.6
Wood Products	2,300	2,270	130	5.9
Metal Mining	1,420	1,380	125	9.1
Coal Mining	740	735	75	10.1
Chemicals	2,315	2,260	255	11.2
Other Industrial	4,170	4,220	440	10.7
Industrial Total	21,605	21,660	1,730	8.0
Commercial				
Trade	3,105	3,100	100	3.2
Service	4,595	4,605	150	3.3
Other Commercial	5,730	5,760	215	3.8
Commercial Total	13,430	13,465	465	3.5
Residential Total	12,745	12,680	910	7.1
Losses,Accruals,& Others	7,255	7,255	-	-
System Total	55,035	55,060	3,105	5.6

** Standard deviation/mean.

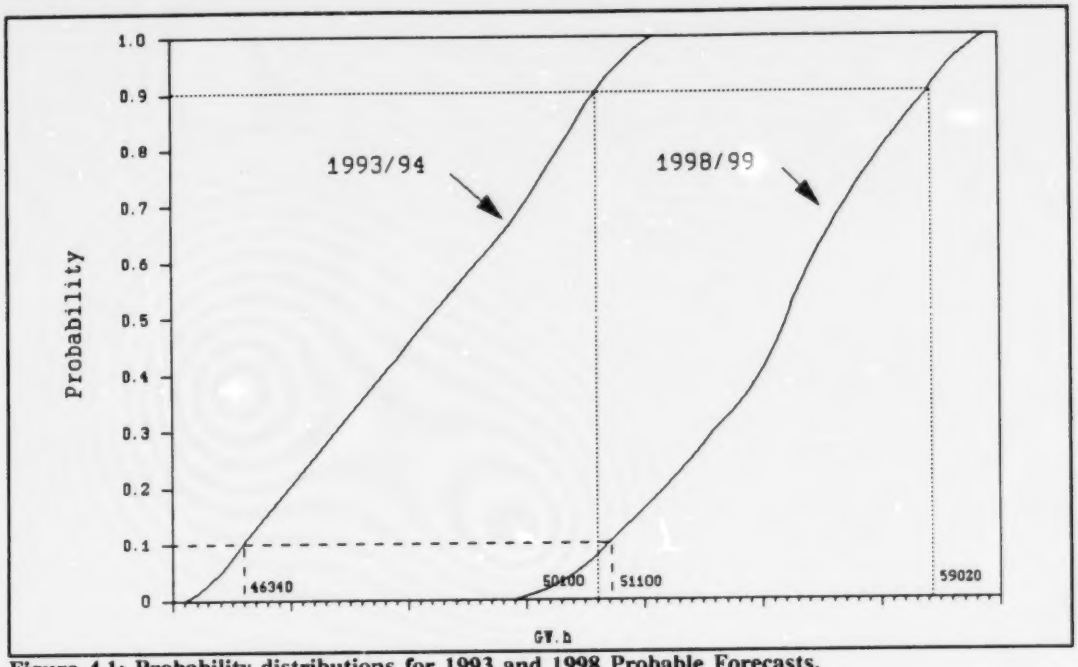


Figure 4.1: Probability distributions for 1993 and 1998 Probable Forecasts.

4.1.2 Probability Distribution Incorporating The Three Economic Scenarios

The development of a probability distribution reflecting the three economic scenarios (the HIGH/PROBABLE/LOW) proceeded by developing high and low energy forecasts based on the high and low economic scenarios assuming the same energy intensity as the probable energy forecast. Then the extent of uncertainty associated with the high and low economic scenarios was assumed the same as the uncertainty surrounding the probable scenario, i.e. the low and high scenarios have the same variance and skewness as the distribution around the probable, but they differ in their means and medians. This assumption was adopted to allow proceeding in a pragmatic manner and beginning to examine the overall distribution associated with all three economic scenarios, even though we have not conducted detailed subjective elicitations for the low and high cases.

The probability of realization of the three different economic scenarios was evaluated with the expert in Central Statistics Bureau, Ministry of Economic Development (MED). The likelihood of the actual GDP falling below the low scenario is assessed to be 10% and the likelihood of actual GDP exceeding the high scenario is 15%.

The results of this analysis is shown in Table 4.2 and graphically in Figure 4.2. For each year, the Gross Load Requirements Forecast is shown as a series of five values:

(i) The 5th percentile. There is a 5% chance that the real value will be below this value.

(ii) The 25th percentile.

(iii) The 50th percentile (median). There are equal (50-50) chances that the real value will be lower or higher than this value.

(iv) The 75th percentile.

(v) The 95th percentile. There is a 5% chance that the real value will exceed this value.

Table 4.2
Total System Probability Distribution
After Integration of Scenario Probabilities
(Gross Requirements GW.h)

Fiscal Year	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile
1993/94	41,245	45,518	48,486	51,035	53,467
1998/99	44,258	50,598	55,740	60,115	65,078

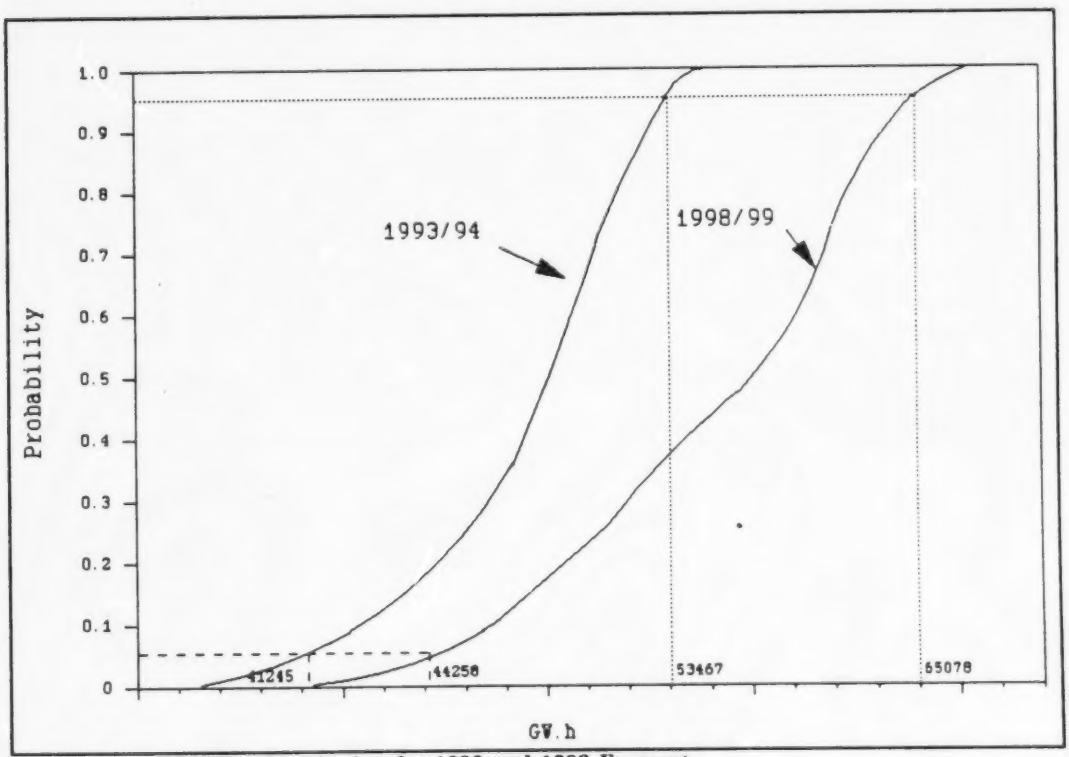


Figure 4.2: Probability distribution for 1993 and 1998 Forecast

There is a 50% chance that the real value will fall in the interquantile range, between the 25th and 75th percentile values.

There is a 90% chance that the real value will fall in the range between the 5th and 95th percentiles as indicated by the dashed and dotted lines in Figure 4.2.

4.1.3 Sensitivity

The sensitivity of the Gross Load Requirement Forecast to changing economic conditions was checked by varying the weighting assigned to probabilities of the three economic scenarios. There is very little change in the values of mean and median throughout the analysis. Including, or varying, the effect of changing economic conditions does not change the general **level** of the forecast for Gross Load Requirements. However, the **variability** of the distribution increases substantially once the varying economic conditions are included. For example, in the 1993 forecast, the standard deviation changes from 1,470 (or 3.05%) to 3,786 (or 7.85%) when economic condition probabilities are included.

Table 4.3
Comparison of Probability Distribution

	Distribution Around Probable Economic Forecast		Distributions Incorporating Variable Economic Forecast	
	Mean	Median	Mean	Median
1993	48,270 (1,470)	48,220	47,995 (3,786)	48,486
1998	55,035 (3,103)	55,060	55,258 (6,236)	55,740

Standard deviation in brackets ( ).

4.2 COMPARISON OF HISTORICAL FORECASTS

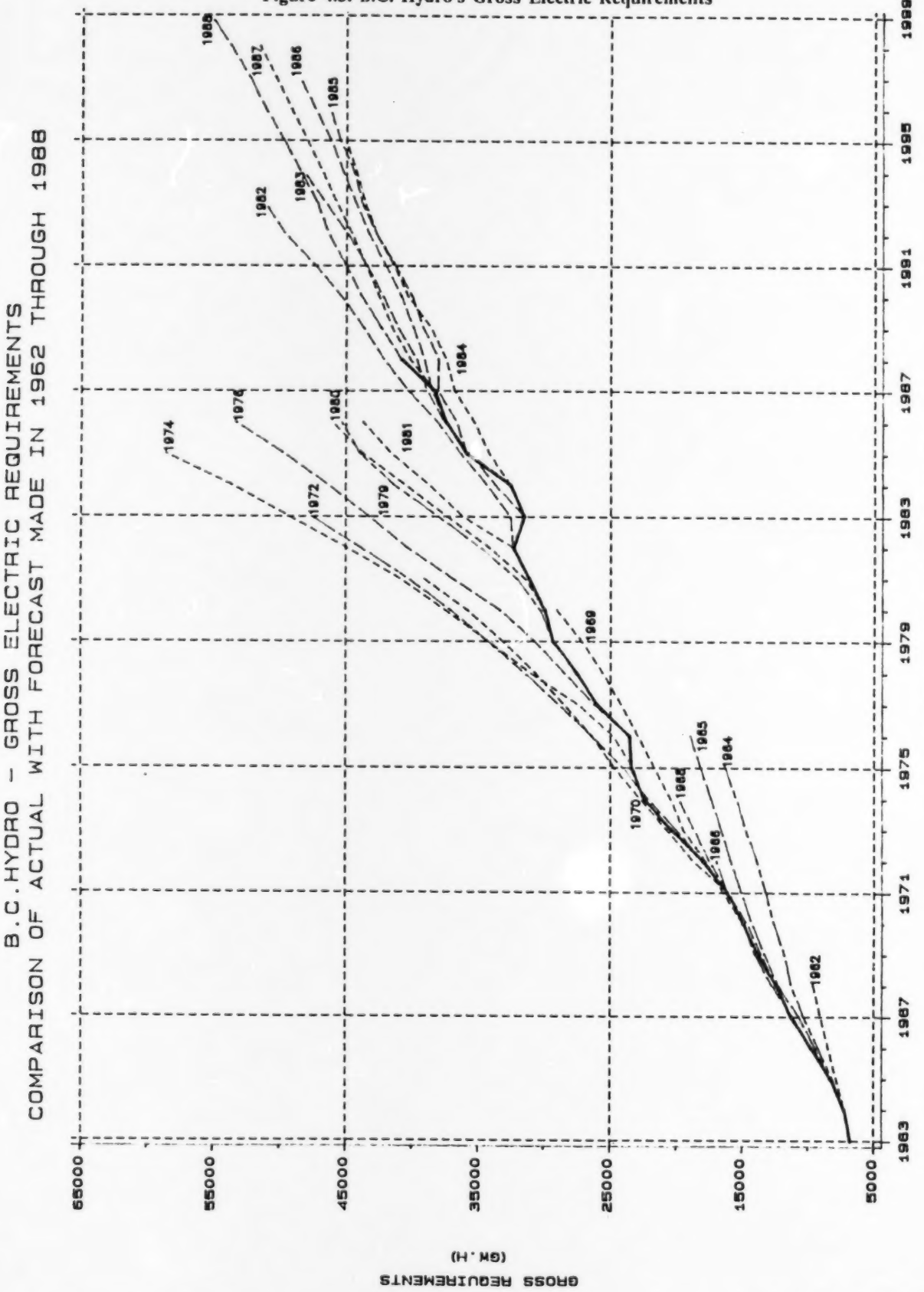
Table 4.4 shows the variance from actual growth in the probable energy forecasts prepared from 1963 on; Figure 4.3 is a graphical representation. Errors were magnified in the forecasts made from 1970 through 1975 because the second 5 years of those probable forecasts were trended to a high projection to ensure an adequate planning reserve.

TABLE 4.4
% ERROR*
YEARS AFTER FORECAST

Date Forecast Made	1	2	3	4	5	6	7	8	9	10	11
Sept. '63	-0.5	-3.5	-9.9	-16.4	-19.7	-24.8	-25.7	-28.1	-31.4	-35.6	-38.0
Sept. '64	-1.6	-3.1	-6.6	-8.0	-14.4	-15.6	-18.1	-22.8	-27.6	-31.3	-30.3
Sept. '65	-0.7	-3.4	0.0	-3.6	-4.5	-6.6	-11.6	-18.5	-22.7	-22.4	-19.5
Sept. '66	1.0	3.8	2.0	-0.5	0.1	-8.6					
Sept. '67	1.4	0.2	1.3	-0.2	-3.8	-9.5					
Sept. '68	-1.6	-1.9	-0.4	-2.6	-8.4	-11.7					
Sept. '69	0.1	1.9	-0.9	-4.4	-9.0	-7.4	-2.8	-7.0	-7.1	-7.4	-3.0
Sept. '70	-0.8	4.2	1.8	1.3	5.6	12.1	9.6	11.4	12.9	19.6	25.5
Sept. '71	0.6	0.9	1.2	6.7	14.7	12.5	15.0	16.5	23.8	29.5	35.7
Sept. '72	-1.8	-1.4	2.8	12.1	11.1	14.4	16.8	23.9	29.3	35.6	51.1
Sept. '73	0.5	4.8	14.0	13.0	17.7	20.5	29.5	36.7	43.5	60.1	68.8
Sept. '74	-0.5	5.3	5.3	12.7	16.7	25.2	31.2	38.9	56.3	64.8	63.5
Sept. '75	-0.6	2.2	5.0	9.9	18.6	26.1	32.6	49.1	58.2	57.2	63.7
Sept. '76	0.7	3.4	4.7	11.3	18.5	24.8	37.2	42.3	38.5	42.4	50.0
Sept. '77	0.4	-0.8	2.3	5.1	7.3	19.0	23.5	19.8	22.1	27.6	28.3
Sept. '78	-1.4	2.0	2.8	5.3	16.7	23.2	19.7	21.7	26.2	25.6	
Sept. '79	1.2	3.0	7.6	20.7	27.1	22.5	21.1	24.1	22.0		
Sept. '80	0.9	5.6	18.5	24.5	21.9	22.9	26.0	25.3			
Sept. '81	-0.1	14.7	18.9	15.9	16.7	20.5	18.7				
Sept. '82	3.4	5.5	1.3	1.7	5.2	3.3					
Sept. '83	3.5	-0.6	0.3	1.5	-2.8						
July '84	-4.7	-5.7	-4.0	-8.3							
July '85	-2.2	-0.6	-6.9								
July '86	0.6	-4.2									
July '87	-1.6										

* Difference between forecast made 1 to 11 years prior to year indicated divided by actual. A negative sign indicates the forecast was lower than actual.

Figure 4.3: B.C. Hydro's Gross Electric Requirements



SECTION 5 - MARKETING AND POWER SMART[1]

There are three sets of programs encompassed under Marketing and Power Smart. They are :

1) The Firm Industrial Marketing Programs;
2) The Interruptible Marketing Programs (E+); and,
3) Power Smart Programs.

Firm Industrial Marketing Programs

These programs were developed to market surplus electricity domestically and also, via reduced electricity rates, allow domestic industry to be more competitive and in some cases remain operating.

Load for the Firm Industrial Marketing Programs is included in the industrial sector forecast. For revenue estimates, however, the Marketing load must be separated out because of the various rates involved.

Interruptible Marketing Programs (E+)

The Interruptible Marketing Programs (E+) were introduced to provide reduced rates to domestic customers by marketing a portion of the secondary energy that is generally available with a hydro generation system.

Load for the Interruptible Marketing Programs (E+) has not been included in the base forecast discussed in this document. Since the load is interruptible under either energy or peak demand supply problems, it is being treated as an add-on for planning purposes.

Power Smart Programs

The Power Smart Programs are intended to reduce load growth by encouraging the more efficient use of energy.

Estimated load reductions from the Power Smart Programs has not been included in the base forecast discussed in this document. The programs are being treated as energy sources (similar to generation projects and other energy acquisition such as through outside purchases) for resource planning. As well, future monitoring and evaluation of the programs will require they be treated distinctly from the base forecast.

The E+ and Power Smart Programs are (being) developed by Marketing Division. To ensure use of a consistent set of numbers for the various planning functions, Forecasting is acting as the coordinator and distributor of the latest official projections.

5.1 FIRM INDUSTRIAL MARKETING PROGRAMS

There are presently two programs under which electricity sales are occurring. A third program, the Turbine Turndown (Rate 1844) program, which allowed the replacement of the customer's own

[1]**POWER SMART** is the name used to encompass the Demand Side Management Programs being initiated by B.C.Hydro.

generation from heavy fuel oil or wood waste/heavy fuel oil, was cancelled effective 31 March 1988. Table 5.1 shows sales for current and cancelled programs.

Industrial Electricity Rate Discount Act - Bill 28 (Rate 1845) involves rates and sales volumes negotiated on an individual customer basis and for varying lengths of time. The Act was introduced to promote increased production, expansion and new industry. Contracts have been negotiated with mining, chemical and pulp and paper customers that continue into the 1990's. No further contracts are being entered into.

Critical Industries Act - Bill 31 (Rate 1846) was introduced to allow reopening or keeping open industries in B.C. through a package that included electricity rate discounts, taxation, labour cost and other concessions. The contracts were negotiated on an individual basis and for varying lengths of time. Contracts, which are primarily with metal mines, will extend sales through 1990/91. No contracts have been negotiated since 1987 and no additional ones will be.

Table 5.1
FIRM INDUSTRIAL MARKETING PROGRAMS

Fiscal Year	Block Recovery (Rate 1843) (GW.h)	Turbine Turndown (Rate 1844) (GW.h)	Industrial Rate Discount Act-Bill 28 (Rate 1845) (GW.h)	Critical Industries Act-Bill 31 (Rate 1846) (GW.h)	Total Industrial Marketing (GW.h)
1984/85 Actual	387	59	0	0	446
1985/86 Actual	121	557	192	143	1,013
1986/87 Actual	0	639	335	591	1,565
1987/88 Actual	0	459	345	776	1,580
FORECAST					
1988/89	-	-	665	568	1,233
1989/90	-	-	1162	456	1,618
1990/91	-	-	807	210	1,017
1991/92	-	-	652	-	652
1992/93	-	-	-	-	0
1993/94 Through.. 1998/99	-	-	-	-	0

5.2 INTERRUPTIBLE MARKETING PROGRAMS (E+)

The intent of the programs is to sell secondary energy at reduced rates for space heating and water heating purposes with the proviso that the service is interruptible. Secondary energy is defined as the energy normally available on an annual basis between critical and normal water years on B.C. Hydro's system. Customers would be interrupted when adequate secondary energy was not available or for certain peak demand critical situations. Recent agreements for improved operation of B.C. Hydro's system have meant less expected secondary energy and thus maximum sales under the E+ programs being substantially reduced. A maximum figure of 500 GW.h (including load transfers from firm electric) is now likely. Table 5.2 details the new load expected to be added but excludes existing load that may transfer to the interruptible (E+) rate.

Table 5.2
INTERRUPTIBLE MARKETING (E+) PROGRAMS

	<----- S A L E S (GW.h) --------> Residential	General	Totals	Losses (@ 15.8%) (Gw.H)	Gross Reqt's (Gw.H)	Peak (MW)
1985/86 Act.	-	-	-	-	-	-
1986/87 Act.	-	-	-	-	-	-
1987/88 Act.	(8)	(2)	(10)	(2)	(12)	(3)
1988/89	38	39	77	12	89	20
1989/90	66	71	137	22	159	36
1990/91	93	95	188	30	218	50
1991/92	120	115	235	37	272	62
1992/93	120	115	235	37	272	62
1993/94	120	115	235	37	272	62
1994/95	120	115	235	37	272	62
1995/96	120	115	235	37	272	62
1996/97	120	115	235	37	272	62
1997/98	120	115	235	37	272	62
1998/99	120	115	235	37	272	62

NOTES:
1. 1987/88 actuals (bracketed) are included in the integrated system.
2. Forecast numbers include only load additions. Load transfers from firm electric are included in the integrated system forecast.
3. Peak demand (MW) is based on an annual load factor assumption of 50%.
4. No Transmission Rate customer load is now anticipated.

The **Residential Program** - (Rate Schedule 1105) involves the addition of electric heating (space or water) with maintenance of the present fuel-fired system as backup. Backup systems may be oil, propane, butane, wood or coal. In addition, existing electric heating systems may qualify for the rate with the addition of an appropriate backup system. This latter type load would have no peak impact on the B.C. Hydro system as it would be a transfer from firm to interruptible load.

The **General Program** - (Rate Schedules 1205, 1206 and 1207) is intended for commercial and industrial customers and is similar to the residential program. It is available for space heating, water heating, and industrial process heating where a permanent backup heating system is maintained which uses oil, propane or a solid fuel.

5.3 POWER SMART PROGRAMS

Power Smart is B.C. Hydro's name for demand side management programs. These programs refer to utility activities designed to influence customer use of energy in a way that will produce desired changes in the utility's load. Both load building and load reduction may be involved. Strategic energy conservation, which may be purchased or induced by other means such as education, is intended to reduce load growth rates. The reduction results from increased efficiency of energy use, on the part of the customer, that has been induced by the utility.

For B.C. Hydro, the benefit of load growth reduction programs results primarily from the impact on the timing of new generation projects and avoidance of energy purchases. This results from the energy-critical (rather than peak-critical) nature of the B.C. Hydro system. Deferral of generation projects results in reductions of both cash flow and revenue requirements.

At the time of the 1987 forecast, five programs were being actively pursued. Since then, however, a much increased emphasis is being placed on the idea of strategic conservation with the goal of making British Columbia "Power Smart". A major revised program is now under development and scheduled for official public launch early in 1989.

Present goals are for gross energy savings in the order of 2,300 GW.h by 1998/99. These savings would be over and above the "natural" (customer induced) conservation assumed to occur in the base forecast contained in this document. Table 5.3 details the savings being assumed in studies for preparation of those areas of the 1988 system plan (distribution and transmission systems) utilizing only the probable energy forecast. Resource (generation) planning uses the Power Smart programs as a probabilistic variable in their resource scenario development thus the numbers provided here may not correspond directly to numbers included in the resource plan.

Table 5.3
POWER SMART (DEMAND SIDE MANAGEMENT) PROGRAMS

	Distribution Rate Customers							Transmission Rate Customers				TOTAL	
	RES (GW.h)	COM (GW.h)	IND (GW.h)	Tot.	Losses (@15.8%) (GW.h)	Total Gross Savings	Peak Saving (59.4% L.F.) (MW)	Sales EE Motors (GW.h)	Losses (@ 8.3%) (GW.h)	Gross Savings (GW.h)	Peak Sav. (80% LF) (MW)	Gross Savings (GW.h)	Peak Savings (MW)
1985/86 Act.	-	-	-	-	-	-	-	-	-	-	-	-	-
1986/87 Act.	-	-	-	-	-	-	-	-	-	-	-	-	-
1987/88 Act.	-	-	-	-	-	-	-	-	-	-	-	-	-
1988/89	1	2	0	3	0	3	1	0	0	0	0	3	1
1989/90	31	18	16	65	10	75	14	70	6	76	11	151	25
1990/91	109	49	34	192	30	222	43	145	12	157	22	379	65
1991/92	200	101	54	355	56	411	79	204	17	221	32	632	111
1992/93	294	183	84	561	89	650	125	302	25	327	47	977	172
1993/94	354	286	102	742	117	859	165	359	30	389	55	1248	221
1994/95	413	392	128	933	147	1080	208	423	35	458	65	1539	273
1995/96	448	484	167	1099	174	1273	245	496	41	537	77	1810	321
1996/97	471	547	183	1201	190	1391	267	541	45	586	84	1977	351
1997/98	492	603	201	1296	205	1501	288	587	49	636	91	2136	379
1998/99	515	673	219	1407	222	1629	313	637	53	690	98	2319	412

APPENDIX A
FORECAST PROCESS AND METHODOLOGY

A.1 FORECAST PROCESS

This year's long range forecast cycle commenced in January with initiation of the major economic studies required as the basis of the energy forecasts. The cycle ends with publication of the complete document ('orange book'). The major inputs, steps and reviews/approval are shown chronologically in Figure A.1.

The source, usage and some brief comments (as seen by the specific consultants) on the major inputs follows:

1. B.C. Long Term Economic Growth Projection - Probable
   - prepared by Ministry of Finance and Corporate Relations (MFCR);
   - 20-year projection of B.C. overall GDP, sectoral GDP and population are main contents used in the energy forecasts.

2. B.C. Long Term Economic Growth Projection - Low and High
   - prepared by Ministry of Finance and Corporate Relations (MFCR);
   - alternate economic growth scenarios used in preparation of the uncertainty (range) in the energy forecasts.

3. Outlook for the B.C. Pulp and Paper Industries to the year 2008
   - prepared by Woodbridge, Reed and Associates;
   - used as basis for the longer term forecast for the paper and allied products sector;
   - in general, longer term growth (beyond 15 years) is projected to be limited by the wood resource availability rather than markets.

4. Forecast of Electricity Consumption by the B.C. Metal Mining, Coal Mining, Industrial Mineral Mining and Smelting Industries
   - prepared by H.N. Halvorson Consultants Ltd.;
   - used as basis for mining and smelting sector forecasts;
   - electric intensive mining industry in B.C. is seen to be limited by low long term outlook for copper prices and limited growth in world requirements for coking coal.

5. Update 1988, Outlook for Crude Oil and Natural Gas Prices
   - prepared by Confer Consulting Ltd.;
   - reviews price outlook to year 2000, small (1 to 2 percent) annual real increases may occur particularly towards end of period.

6. Electricity Prices
   - based on projected future revenue requirements, real price declines of 1-1/2 percent per year seen through initial 10-year period.

7. Divisional Customer Forecasts
   - prepared by each of B.C. Hydro's four divisions;
   - short term (3-year) projections of residential and general customer additions;
   - form basis for total short term customer forecast and divisional energy forecast splits.

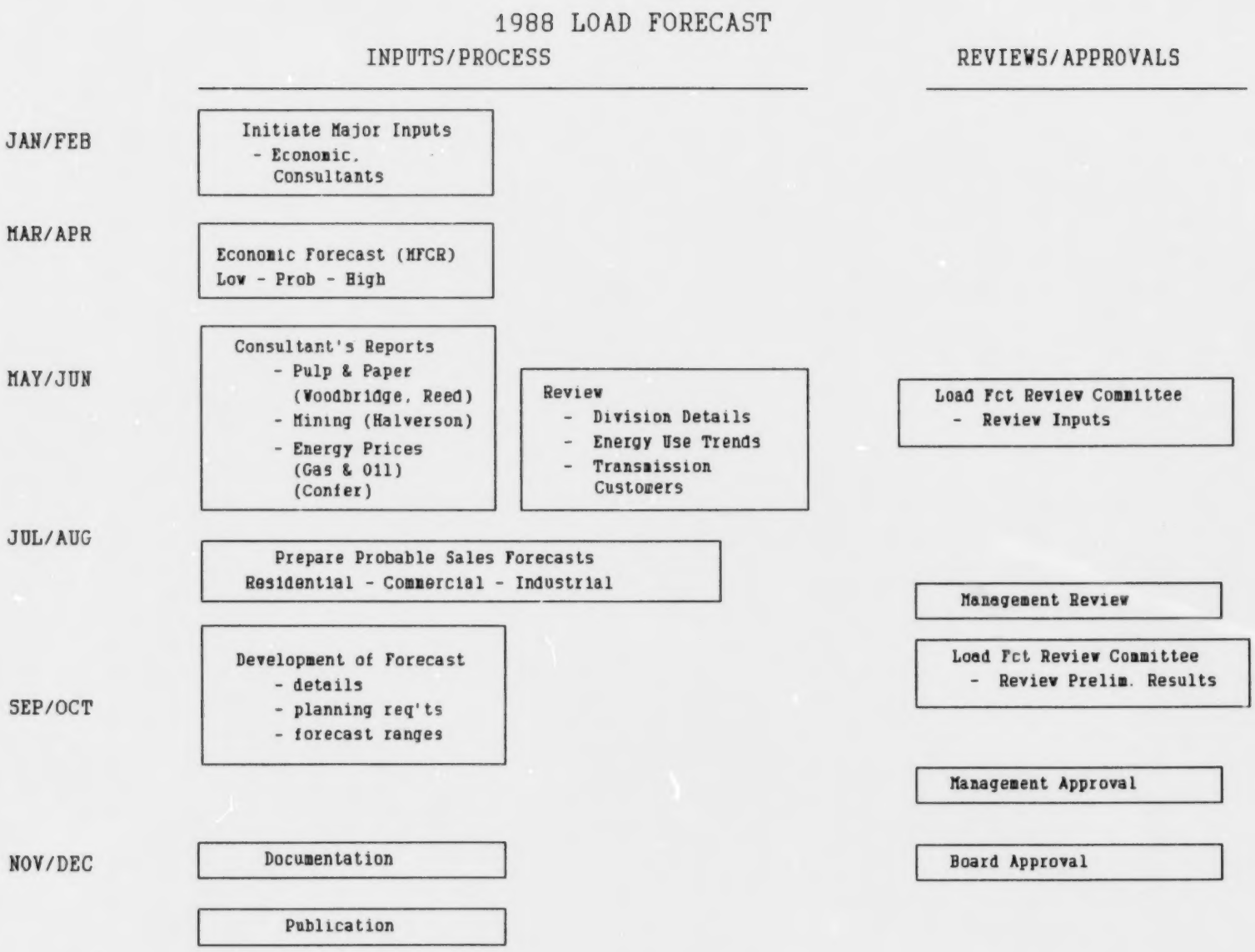


Figure A.1: 1988 Load Forecast Process

8. Conservation, Interruptible Marketing (E+) and Demand Side Management (DSM Power Smart)
   - supplied by Energy Management (section of B.C.Hydro);
   - non-induced (i.e. efficiency and usage improvements that would occur with no involvement by B.C. Hydro) conservation is agreed on and included in the base forecast;
   - E+ and DSM programs are not included in the base forecast.

9. Transmission Customer Plans - Short Term
   - supplied by Transmission Supply Marketing (section of B.C.Hydro) on individual basis;
   - used as basis for most sectors of short term industrial forecast as 80% of industrial sales are to these large customers (approximately 80 in total).

A.2 METHODOLOGY

The population, economic, sectoral and energy price forecasts described in the previous section are translated into electricity requirements using a "top down/end use" approach to forecasting. The top down aspect of the approach entails the use of the population and economic forecasts and sectoral outlooks to project the household formation, commercial activity and industrial production that generate the need for electricity. The end use focus consists of analysis of how various customers presently use electricity and how consumption patterns are likely to change in the future.

The effects of energy price changes are examined by first establishing the scope customers have for changing electricity use by measures such as: installing more efficient appliances and higher levels of insulation, choosing an alternative source of energy for heating, switching to more efficient lighting, substituting other energy sources or modifying the way electricity is used in existing industrial processes, changing industrial processes, or self-generating electricity rather than purchasing.

Preparation of the probable energy forecast includes the development of short and long term sales, energy and peak requirements. Regional details by rate category are developed for 11 years and summary level projections are developed for 21 years for use in long range planning. Also monthly details for the next fiscal year are prepared for use in revenue projections. A 10-year revenue forecast is also prepared.

The forecast is developed by residential, commercial and industrial sectors which are allocated to rate categories later in the process. Details on development of the forecasts for these main sectors follow:

a) Residential

The residential forecast (see Figure A.2) is developed with the use of two models - the cohort survival model and the residential model. Starting with demographic projections of fertility, mortality and migration, an age specific population forecast, by operating division (region), is developed using the cohort model. The provincial level results are compared and made to conform with the Ministry of Finance and Corporate Relations (MFCR) population projection. The detailed results become one input to the residential model.

The residential model is an end-use stock model. That is, it starts with an age specific regional population projection and through projections of headship rates and dwelling preferences, develops a regional housing stock for each year of the forecast. Based on a base year load profile for each dwelling type in each region, and projections of usage trends for space heating, water heating, lighting and ten major appliances, the model develops energy sales forecasts. Also included in the model are considerations of space heating fuel choices based on fuel prices, furnace efficiencies, and gas availability; demolitions, conversions, and retrofitting of housing stock; and penetrations and life cycles of various appliances.

Also, an elaborate procedure exists for developing projections of short-term (3-year) account additions from the operating personnel in the field. Starting at the District level, Residential heating and non-heating (plus General under 35 kW and General, 35 kW and over) category customers are summated to the Division level. These numbers are compared to the results based on the long-term methodology and via review meetings between Load Forecast and Divisional staff, short-term customer numbers are determined. The customer numbers become the basis for providing Divisional energy projections for distribution planning purposes.

The historical energy data that is essential to the forecast analysis is maintained by the Forecasting Department. It is used in part for the weather normalization procedure which provides adjusted use data for the base year load profile.

Under active study is the acquisition of a new residential end-use model. The requirement is two-fold. To facilitate development and handling of Power Smart programs, a model beyond the capabilities of our existing one is required by both Forecasting and Marketing. Also, price effects and their sensitivities cannot be readily addressed in our present model, they must be handled exogenously. Acquisition of an existing outside model appears to be more cost and time effective than further (extensive) development of the existing model.

b) **Commercial**

The commercial forecast (see Figure A.3) is developed from an analysis of the five main components (by Standard Industrial Classification - SIC). For each component the sectoral GDP projection is analyzed to determine the portion of GDP that may be attributable to growth in stock. Stock growth is then related to various building floorspace components and this is combined with load profiles and projections of energy use for the various types of floorspace. The health and education categories are projected separately using models that utilize age specific components of the population.

The ICA (Industrial Consumption Analysis) System is essential to the load analysis in the commercial sector. B.C. Hydro customers are coded by SIC in the ICA system allowing load data to be analyzed and projected consistent with the categorization of the sectoral economic drivers.

COMMEND, the EPRI commercial end use model, was recently acquired. Implementation and data collection is now proceeding. The model will be used in preparation of the 1989 commercial forecast.

c) **Industrial**

The industrial forecast is based on detailed analysis of each sector (SIC). For the areas of greatest significance, forestry and mining, world market perspectives as obtained from consultants, were used as the basis of the longer term forecast. Production levels are analyzed in relation to provincial sectoral GDP forecasts. Patterns in energy intensity are considered in relation to technological change. Specific customer information is obtained and utilized to mold the short-term projections relative to the macro industry outlook.

The forecast is prepared on a customer specific basis for the large transmission rate accounts. The ICA system is also essential to load analysis in the industrial sector.

Use of specific key sector end use models is to be investigated. With support from B.C. Hydro, a pulp and paper sector model (one sector from ISTUM, a U.S. developed industrial process model) has been applied to B.C. It is to be reviewed for possible ongoing use and further development by Forecasting.

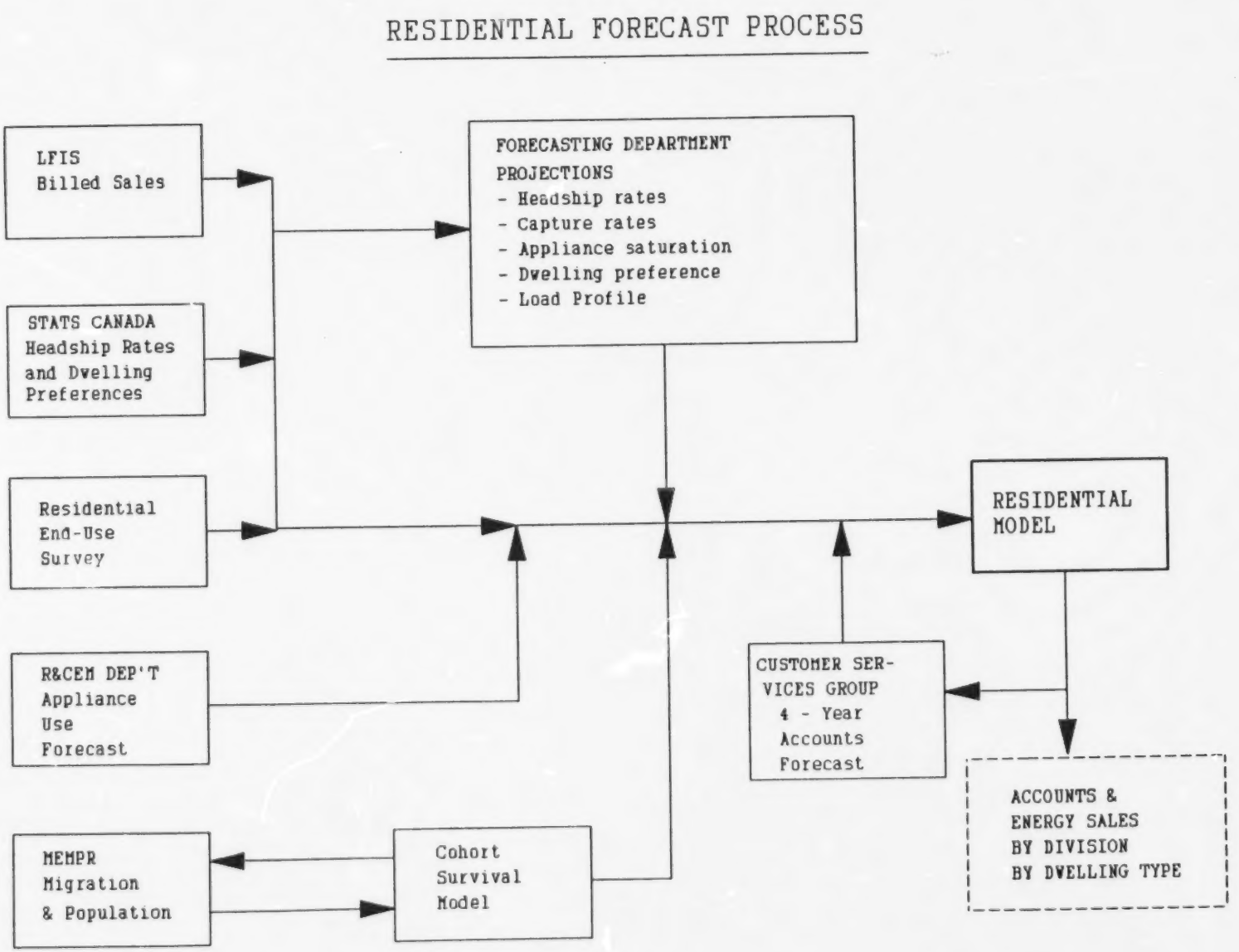


Figure A.2: Residential Forecast Process

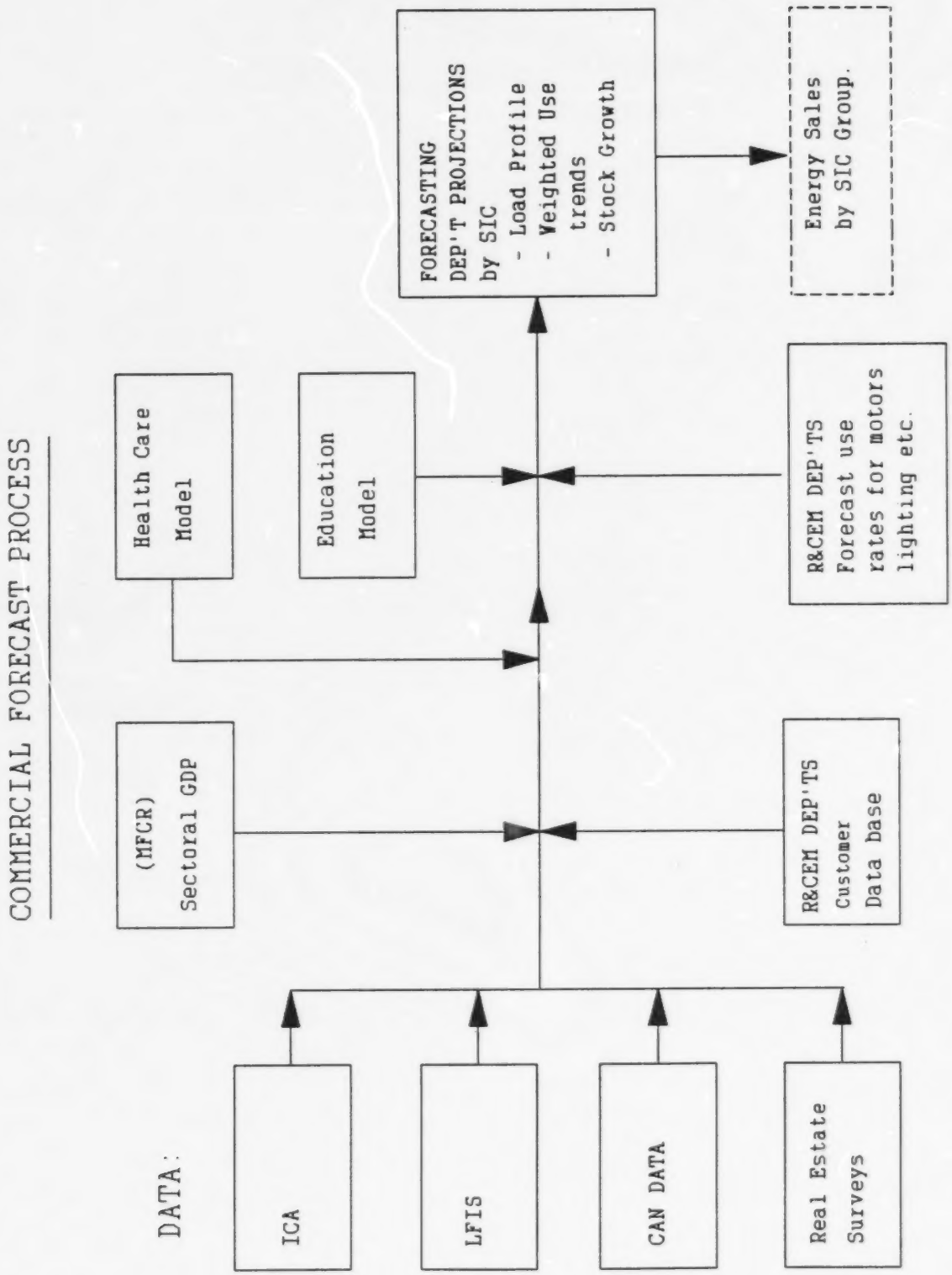


Figure A.3: Commercial Forecast Process

A.3 UNCERTAINTIES

The 1988 probability assessment for the probable economic forecast proceeded as follows:

- an uncertainty model employing Monte Carlo simulation methods was constructed to quantify and combine probability distributions on key variables;
- the model was structured in terms of three major sectors: industrial, residential, and commercial;
- each of the three major sectors was disaggregated into subsectors: under industrial there are six subsectors (pulp and paper, wood products, chemicals, coal mining, metal mining, and other); under residential, two subsectors (heating and non-heating); and under commercial, three subsectors (trade, service, and other);
- for each sector, one or two key variables were identified that have the largest effects on uncertainty over electrical sales in that sector. For example, the rate of new household formation has a major effect on the number of residential accounts, given a population forecast;
- a trained probability assessor worked with staff in B.C. Hydro's Forecasting group to subjectively assess conditional probability distributions over each of these key variables, assuming that the probable GDP forecast occurs;
- the uncertainty model was then used to combine these probability distributions and the other factors to develop probability distributions for sales in each sector, which were combined into an overall sales forecast distribution;
- the key assumptions for these assessments were that total GDP, population, and sectoral GDP are held constant at the probable forecast level;
- the probability distributions for variables in all sectors were assumed to be conditionally independent, in statistical terms.

The development of a probability distribution reflecting the three economic scenarios proceeded in the following manner:

- It was assumed that the extent of uncertainty associated with the high and low economic scenarios is the same as the uncertainty surrounding the probable scenario. That is, the distributions around the low and high scenarios have the same variance and skewness as the distribution around the probable, but they differ in their means and medians. This assumption was adopted to allow proceeding in a pragmatic manner and beginning to examine the overall distribution associated with all three economic scenarios, even though we have not conducted detailed subjective elicitations for the low and high cases.
- To construct one overall probability distribution reflecting the three scenarios, it was necessary to attach a probability to each scenario. A trained probability assessor worked with an expert in Central Statistics Bureau, Ministry of Economic Development (MED) to quantify the probability of realization of the three different economic scenarios. In the judgement of MED's expert, the likelihood of the actual GDP falling below the low scenario is 10% and the likelihood of actual GDP exceeding the high scenario is 15%.
- Given probabilities for each of the three scenarios and distributions around each of the scenarios, the overall probability distribution incorporating uncertainties associated with all three scenarios was estimated.

- Sensitivity analysis was also conducted. A symmetric (25%) probability was placed on the low and high economic scenarios, and 50% on the probable economic scenario to construct an overall distribution, to see how sensitive the results were to MED's views on the likelihood of falling below the low scenario or exceeding the high scenario.

A.4 DETAILED INPUTS TO THE FORECAST

The following provides detail of the major inputs and sources of information that drive the forecasts:

a) **Residential**

- Migration and total population forecasts are obtained from Central Statistics Bureau (B.C.) in the Ministry of Finance and Corporate Relations (MFCR).
- Historic fertility, mortality, migration, migrant age profile, and census population are obtained from Statistics Canada.
- Historic headship rates and dwelling preference are obtained from Statistics Canada.
- B.C. Hydro accounts by dwelling type and by region are obtained from the Customer Services Group.
- Demolition and conversion data come from the Commercial Activity Report (CAR) generated by Customer Services.
- Four-year account projections are developed in the field and cumulated by Customer Services.
- Historical account and total energy use information is obtained from the Load Forecast Information System (LFIS) - adjusted billing statistics.
- Degree day statistics are obtained from the Residential and Commercial Energy Management Departments (R&CEM).
- Base year load profiles are developed using the Residential End-Use Survey - 1984 for appliance saturations and Energy Management data sheets specifying estimated consumption rates for appliances.
- Projections of trends in energy consumption for appliances come from Residential and Commercial Energy Management Departments (R&CEM).
- Comparative information on appliance saturations and use trends are obtained from other utilities through the Canadian Electrical Association (CEA) and the Electric Power Research Institute (EPRI) in the U.S.
- Space heating capture rates are available from Customer Services.
- Furnace efficiencies are determined from information from Residential and Commercial Energy Management Departments (R&CEM).
- Energy price projections are developed with assistance from consultants.

b) **Commercial**

- Sectoral GDP projections come from the Ministry of Finance and Corporate Relations (MFCR).
- Historical sales data is from LFIS and from the ICA System.
- Building stock growth comes from real estate surveys and from CanData, a data series providing actual construction starts by building type.
- Load profiles are developed from Residential and Commercial Energy Management (R&CEM) data and from other utility data.
- Use patterns for various building types are obtained from a customer data base maintained by Residential and Commercial Energy Management (R&CEM).
- Forecast use trends are developed from specific application trends given by Residential and Commercial Energy Management (R&CEM).
- Health care statistics are obtained from provincial agencies.
- School data and trends in area per student are obtained from the Ministry of Education.

c) **Industrial**

- Sectoral GDP projections come from Ministry of Finance and Corporate Relations (MFCR).
- Key industry (electric intensive) world and provincial outlooks are obtained from consultants.
- Historic consumption data comes from LFIS/ICA and the Customer Information Control System (CICS).
- Short-term projections (1 to 5 years) are based on consultation with all major customers through the Transmission Supply Marketing Department.
- Energy use trends are obtained from recent studies, consultant inputs and historical trends.
- Reviews of the key sectors of the projections are solicited from provincial government agencies, consultants and other organizations.

APPENDIX B
RATE CATEGORIES

The forecast, as described in the body of this document, is developed along homogenous sectors, i.e. residential, commercial and industrial. For certain planning functions and revenue projections, however, it is necessary to transcribe the probable (base) forecast into rate categories.

A discussion of the rate categories and how they are estimated follows:

Residential
This category equates directly to the residential sector forecast and thus requires no translation.

General, Under 35 kW
This category encompasses mainly small commercial customers, e.g. the "corner store", and thus is contained largely in the commercial sector forecast. Customers are related to total General and Residential customers. Usage rates are based on historical trends. Customers, usage rates and thus total sales are compared with the total General category (i.e. including General, 35 kW and Over).

General, 35 kW and Over
This category contains larger commercial and smaller industrial customers. The projections, for consistency, are done concurrently with the General, Under 35 kW category, for customers, usage rates and total sales. As well, plans for transfer of larger customers to the Transmission Rate category are considered.

Transmission Rate
Included here are customers that have a demand of 5 MW or larger. These customers (approximately 80 at the end of 1987/88) are the larger industrial accounts such as pulp and paper mills, mines and chemical plants. Also included are refineries, some of the larger wood manufacturing facilities and some of the larger commercial customers such as U.B.C., grain and other bulk loading terminals. Projections in the short term are based on customer inputs and in the longer term are related to industry outlooks and projections.

Irrigation, Street Lighting and B.C. Hydro Own Use
These are small specific rate categories that are assumed to all be within the commercial sector.

Firm Industrial (Domestic) Marketing Programs
These loads are within the industrial sector and are primarily dealt with on an individual customer basis.

Table B.1 provides historical data and the forecast through 1998/99 by rate categories.

For relating commercial and industrial sales to the major rate categories, refer to Tables in Section 3.

Table B.1
B.C. HYDRO HISTORICAL AND PROBABLE ELECTRIC SALES FORECAST BY RATE CATEGORIES
(Billed Sales, No Adjustment For Accrual)

Fiscal Year	Resident. (GW.h)	-- General -- Under 35 kW (GW.h)	35 kW & Over (GW.h)	Trans. Rate (GW.h)	Irrig-ation (GW.h)	St. Light. (GW.h)	BCH own Use (GW.h)	Dom. Mktg. (c) (GW.h)	Firm Exp. + Inter-Util. (a) (GW.h)	Total Billed Sales (GW.h)
HISTORICAL										
1977/78	7,051	2,101	5,972	8,479	39	191	127		204	24,164
1978/79	7,492	2,159	6,353	9,133	35	198	132		218	25,720
1979/80	7,727	2,213	6,736	9,217	50	206	142		227	26,518
1980/81	8,042	2,226	7,118	9,597	41	220	89		231	27,564
1981/82	8,640	2,328	7,378	9,339 (b)	41	224	98		260	28,308
1982/83	8,821	2,301	7,403	9,046	47	228	99		261	28,206
1983/84	9,005	2,251	7,578	9,074 (b)	49	226	85	190	262	28,720
1984/85	9,577	2,423	7,917	10,498	56	230	89	446	267	31,503
1985/86	9,793	2,494	8,343	10,650	68	238	89	1,010	452	33,137
1986/87	9,666	2,426	8,546	11,134	57	239	81	1,543	622	34,314
1987/88	9,902	2,590	9,040	11,994	76	241	79	1,580	682	36,184
Avg. Annual Growth: %										
10 years: 77/78-87/88	3.5%	2.1%	4.2%	3.5%	6.9%	2.4%	-4.6%	-	12.8%	4.1%
FORECAST										
1988/89	10,298	2,673	9,336	12,850	67	246	83	1233	705	37,491
1989/90	10,530	2,741	9,431	13,340	69	250	84	1618	768	38,831
1990/91	10,763	2,838	9,738	14,370	72	254	86	1017	751	39,889
1991/92	10,995	2,936	10,077	14,915	75	258	88	652	1,036	41,032
1992/93	11,219	3,040	10,411	15,605	78	263	89	0	1,088	41,793
1993/94	11,451	3,145	10,762	15,950	81	269	91	0	1,135	42,884
1994/95	11,691	3,257	11,137	16,290	83	274	93	0	1,196	44,021
1995/96	11,922	3,375	11,549	16,655	87	280	95		1,261	45,224
1996/97	12,142	3,502	11,968	16,870	89	286	96		1,333	46,286
1997/98	12,356	3,633	12,408	17,245	92	292	99		1,390	47,515
1998/99	12,576	3,763	12,865	17,795	95	298	101		1,455	48,948
Avg. Annual Growth: %										
11 years: 86/87-97/98	2.2%	3.5%	3.3%	3.7%	2.0%	1.9%	2.3%	-	7.1%	2.8%

(a) "Firm Export & Inter-Utility" column includes: New Westminster, Point Roberts, Hyder, Out of Province (Alberta), Seattle City Light and W.K.P.& L.
(b) Forest industry labour disruptions in 1981/82 and 1983/84 caused reductions in Transmission Rate sales.
(c) Firm Domestic Marketing Programs are detailed in Table 5-1.

APPENDIX C
THE B.C. HYDRO SYSTEM AND FORECAST USE

This load forecast is utilized by the various System Planning functions in preparing the development plans for the distribution, transmission and generation systems. This appendix provides an overview of the B.C. Hydro system as to what loads Forecasting includes in the various sectors and tables in this document. Also provided is a description of the various formats of the peak demand forecast(s) prepared and how consistency between the various uses is ensured.

C.1 THE B.C. HYDRO SYSTEM

The **B.C. Hydro Domestic System** is defined here to include all firm load within B.C. Hydro's service area. **Included** are the Firm Industrial Marketing programs and the out of province firm sales to Point Roberts, Hyder and the Peace River area in Alberta. **Excluded** are the Interruptible Marketing (E+) programs, Power Smart (Demand Side Management) programs and sales to West Kootenay Power and Light (WKP&L) and Seattle City Light (SCL).

The **Integrated Domestic System** is defined as the above Domestic System less the **Non-Integrated System**. The non-integrated consists primarily of diesel served areas, the total load is small accounting for 167 GW.h and 32 MW in 1987/88.

Breakdown of the load into segments is required for the various planning functions for which the forecast is used. The **Integrated System**, that most tables in this document depict includes the above integrated domestic system plus WKP&L and SCL requirements. This is the level at which major studies, e.g. generation requirements, are carried out.

C.2 DISTRIBUTION SUBSTATION FORECASTS[2]

To provide consistency between the Divisional energy sales forecasts prepared by Forecasting and the distribution substation peak demand forecasts prepared by the Divisional Engineering Departments, the following procedure is followed.

Forecasting provides (see Appendix A for derivation) a 10-year energy sales forecast to Distribution Technical Services. This is a forecast of distribution sales (residential, general, irrigation, street lighting, B.C. Hydro own use, marketing and demand side management) for each of the next 10 years by operating division.

Distribution Technical Services uses the Divisional distribution sales forecasts as a proxy for estimating Divisional distribution substation (sum of substations in Division) peak demand forecasts. Allowable variances in peak demand growth from the sales growth forecasts are also provided. The variance guideline is drawn from the historical correlation of actual annual Divisional demand and actual energy sales over the past 10-year period. The average annual demand growth has paralleled the energy growth over this period with a variance of 1 year in 10 or better for each Division, except Vancouver Island which has been 1 year in 7.5. Acceptable lower and upper ranges for the additive substation peak demand average annual growth rates by Division are provided to the Divisional Engineering Departments.

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[2]Refer to manual, Distribution Planning Practice, Section 2, for further details.

The Divisional Engineering Departments assign load growth to the various distribution substations in their Division so that the overall annual growth in Divisional demand satisfies the guideline.

The distribution substation forecasts are used in distribution and transmission planning.

C.3 CUSTOMERS SERVED AT TRANSMISSION VOLTAGES

The majority of these customers are in the Transmission Rate category. There are some customers (generally less than 5 MW size and for special circumstances), however, that are served at a transmission voltage (defined in this instance as 60 kV or higher) and fall in the General Rate category. These transmission customers are treated separately for planning purposes.

Forecasting provides peak demand forecasts for all transmission voltage customers. Peaks are generally based on the individual sales projections.

The transmission voltage customer peak forecasts are used along with distribution substation forecasts for transmission planning.

C.4 SYSTEM PEAK FORECAST[3]

Forecasting provides, based on the total energy forecast, a system peak projection at the generation level.

This forecast is used in generation planning and as a check in transmission planning. The additive peaks of distribution substation and transmission voltage customer with losses added are diversified, using historical relationships, and checked against the calculated system peak. Thus a "closed loop" ensures consistency in all levels of peak forecasts being used. (Refer to Figure C.1).

[3]See Section 3.0 for details on calculation.

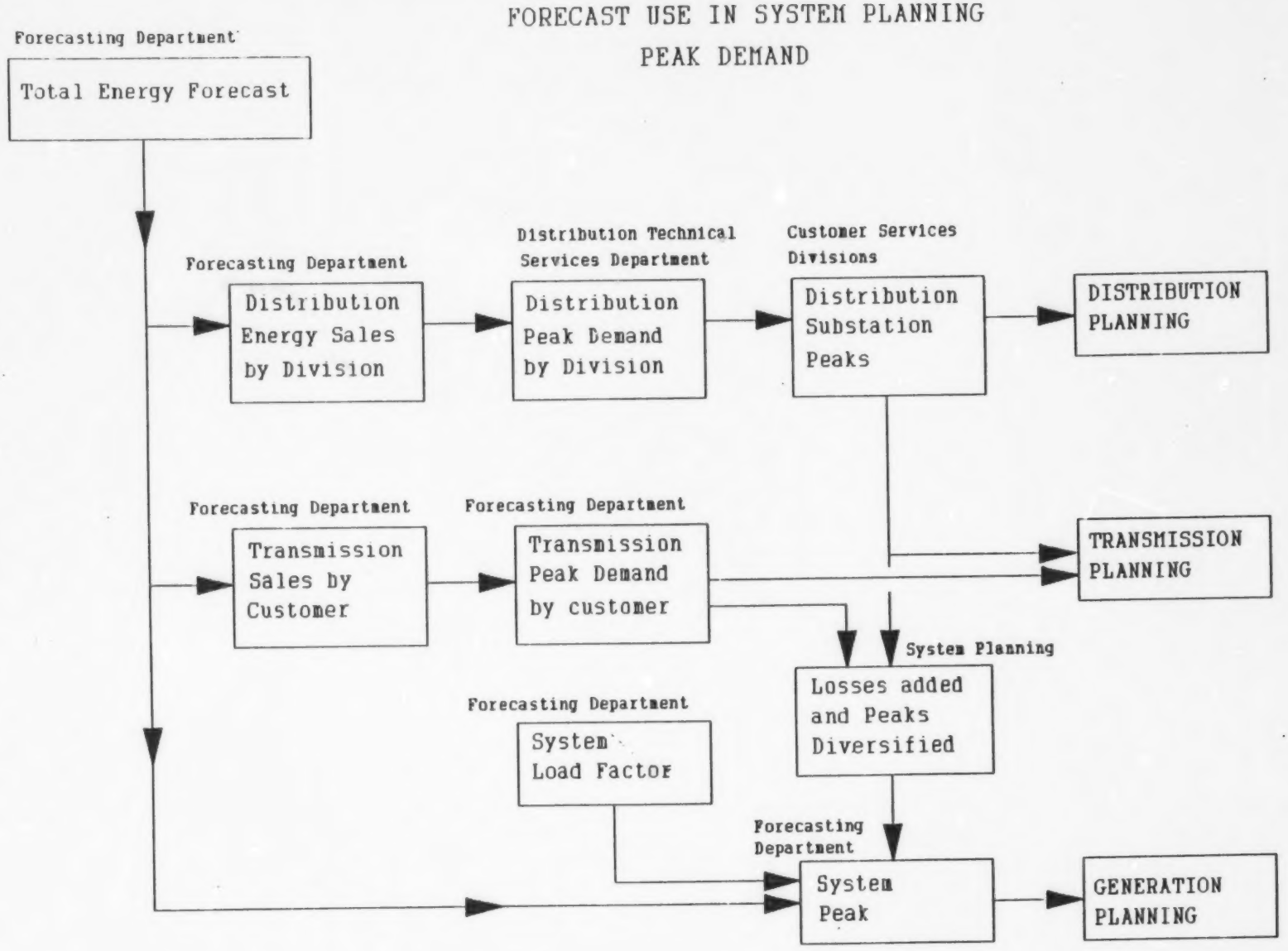

Figure C.1: Forecast Use in System Planning Peak Demand